Seagate

Medalist Pro Family

Medalist 2160N (ST52160N)

Medalist 2160WC (ST52160WC)

SCSI Interface Drives

Product Manual

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Publication Number: 32650-001, Rev. A, December 1996

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Contents

Introduction 1
Specifications summary table 3
1.0 Specifications summary 5
1.1 Formatted capacity 5
1.2 Physical geometry 5
1.3 Functional specifications 5
1.4 Physical dimensions 6
1.5 Seek time 6
1.6 Read look-ahead and caching 7
1.7 Start/stop command 7
1.7.1 Power-up sequence 7
1.7.2 Power-down sequence 8
1.7.3 Auto-park 8
1.8 Power management 8
1.8.1 Power consumption 9
1.8.2 Voltage tolerance 9
1.8.3 Input noise 10
1.9 Environmental 10
1.9.1 Ambient temperature (HDA case) 10
1.9.2 Temperature gradient 10
1.9.3 Altitude 10
1.9.4 Relative humidity 11
1.10 Shock and vibration 11
1.11 Acoustics 12
1.12 Reliability 12
1.13 Agency listings 12
1.14 Electromagnetic Compliance for the European Union . . . 13
1.15 FCC verification 13
2.0 Hardware and interface 17

2.1 SCSI-3 compatibility 17
2.2 Handling and static-discharge precautions 17
2.3 Electrical interface 18
2.4 Interface and connector configuration 19
2.5 ST52160N interface connector 20
2.5.1 ST52160N interface pin assignments 21
2.5.2 ST52160WC interface connector 22
2.5.3 ST52160WC interface pin assignments 22
2.6 Interface cable requirements 25
2.6.1 Interface cable length for asynchronous operation . . . 25
2.6.2 Interface cable for Fast SCSI operation 25
2.6.3 Interface cable for UltraSCSI operation 25
2.7 Options jumper block 26
2.7.1 SCSI address 26
2.8 Active Termination 29
2.9 Parity enable option 29
2.9.1 Motor Start option 29
2.9.2 Remote LED connection 29
2.10 Daisy chaining 29
2.11 Hot-plugging 30
2.12 Mounting the drive 30
3.0 Command set 35
3.1 Command descriptor block 35
3.2 Status byte 35
3.3 Supported commands 36
3.4 Group 0 commands 37
3.4.1 Test Unit Ready command (00_H) 37
3.4.2 Rezero Unit command (01_H) 38
3.4.3 Request Sense command (03_H) 38
3.4.4 Format Unit command (04_H) 39
3.4.5 Reassign Blocks command (07_H) 43

3.4.6 Read (6) command (08_H) 45
3.4.7 Write (6) command ($0A_H$) 46
3.4.8 Seek (6) command ($0B_H$) 47
3.4.9 Inquiry command (12_H) 47
3.4.10 Mode Select (6) command (15_H) 48
3.4.11 Reserve (6) command (16_H) 51
3.4.12 Release (6) command (17_H) 52
3.4.13 Mode Sense (6) command ($1A_H$) 53
3.4.14 Start/Stop Unit command ($1B_H$) 56
3.4.15 Receive Diagnostic Results command ($1C_H$) 57
3.4.16 Supported Diagnostic Pages 58
3.4.17 Translate Address Page 59
3.4.18 Send Diagnostic command ($1D_H$) 61
3.5 Supported Diagnostics Page—Send Diagnostics 62
3.6 Translate Address Page—Send Diagnostic 62
3.6.1 Read Capacity command (25_H) 63
3.6.2 Read (10) command (28_H) 64
3.6.3 Write (10) command ($2A_H$) 65
3.6.4 Seek (10) command ($2B_H$) 66
3.6.5 Write and Verify command ($2E_H$) 67
3.6.6 Verify command ($2F_H$) 68
3.6.7 Read Defect Data command (37_H) 68
3.6.8 Write Data Buffer command ($3B_H$) 70
3.6.9 Read Data Buffer command ($3C_H$) 72
3.6.10 Read Long command ($3E_H$) 74
3.6.11 Write Long command ($3F_H$) 74
3.7 Group 2 commands 75
3.7.1 Log Select command ($4C_H$) 75
3.8 Log Sense command ($4D_H$) 82
3.9 Reserve (10) command (56_H) 83
3.10 Release (10) command (57_H) 84

3.11 Group 3 and 4 commands 85
3.12 Group 5 and 6 commands 85
3.13 Group 7 commands 85
Appendix A. Supported messages 87
A.1 Messages 87
A.2 Synchronous Data Transfer Request message (01_H) 88
A.2.1 Wide Data Transfer Request Message 89
Appendix B. Sense data 91
B.1 Additional sense data 91
B.2 Sense key 93
B.3 Additional sense code and additional sense code qualifier . 94
Appendix C. Mode pages 97
C.1 Read-Write Error Recovery page (01H) 98
C.2 Disconnect/Reconnect page (02_H) 100
C.3 Format Device page (03_H) 102
C.4 Rigid Disc Geometry page (04_H) 104
C.5 Verify error recovery page (07_H) 107
C.6 Caching page (08_H) 108
C.6.1 Read look-ahead and caching 108
C.6.2 Write caching and write merging 109
C.6.3 Caching page description 110
C.7 Control Mode page ($0A_H$) 113
C.7.1 Unit Attention Parameters (00_H) 114
Appendix D. Inquiry data 117
D.1 Inquiry data 117
D.2 Vital product data pages 120
D.2.1 Unit Serial Number page (80_H) 121
D.2.2 Implemented Operating Definition page (81_H) 121
D.2.3 Firmware Numbers page ($C0_H$) 122
D.2.4 Date Code page ($C1_H$) 123
D.2.5 Jumper Settings page ($C2_H$) 123

Figures

Figure 1. Typical startup current profile 7
Figure 2. Single-ended transmitter and receiver 18
Figure 3. Connectors 19
Figure 4. ST52160N jumper settings 27
Figure 5. ST52160WC jumper settings 28
Figure 6. ST52160N Mounting dimensions 32
Figure 7. ST52160WC Mounting dimensions 33

Introduction

This manual describes the functional, mechanical and interface specifications for the Medalist® Pro 2160N and Medalist Pro 2160WC SCSI hard disc drives. The Medalist Pro 2160N is referred to in this manual by its model number ST52160N. This drive comes with the standard 50-pin interface connector. The Medalist Pro 2160WC is referred to in this manual by its model number ST52160WC. This drive comes with the 80-pin blindmate single-connector attachment (SCA-2).

Seagate desktop products take a step into the future with the ST52160N and ST52160WC. These drives feature MR heads and PRML recording technology.

The Medalist Pro drives uses an UltraSCSI interface. The ST52160N supports a synchronous external transfer rate of up to 20 Mbytes per second. The ST52160WC supports a synchronous external transfer rate of up to 40 Mbytes per second.

These drives have other features that ensure fast data throughput. The ST52160N uses a 128-Kbyte buffer. The ST52160WC uses a 256-Kbyte buffer. The adaptable cache aids the flow of read and write data. Embedded servo technology allows the drives to position the heads for data retrieval efficiently and accurately while eliminating the periodic thermal recalibration that can interrupt during data transfers. These drives also use a 16-bit microprocessor and an intelligent controller that provides data streaming: direct data transfers between the drive and the host without microprocessor intervention. This feature allows for a sustained data rate that facilitates video playback and other multimedia operations.

The drives conform to the standard 3.5-inch footprint but have a 0.75-inch (19 mm) height profile and a 5.380-inch depth profile. The lower height and shorter depth gives the designer or integrator more room for air circulation, other peripherals or a smaller drive bay.

The SCSI commands the drives support are listed in Section 3.3. on page 36.

The following is a summary of the drives' features:

Capacity

- 2.17 Gbytes, guaranteed

Features

- SCSI-3 SPI and SCAM Plug and Play compliant
- 8-bit and 16-bit UltraSCSI
- Transfer rates up to 20 Mbytes and 40 Mbytes per second
- 11-msec average seek time
- 5,379-RPM rotational speed
- 5.56 average latency
- 128-Kbyte[1] and 256-Kbyte[2] buffer
- Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.)
- Rotational-position seek/sort
- On-the-fly ECC correction
- Embedded servo
- PRML channel
- MR heads

Acoustics

- 3.4-bel idle sound power level
- 27-dBA idle sound pressure level

Mini 3.5-inch form-factor

- 19-mm-height profile
- Fits standard 3.5-inch footprint

1. ST52160N

2. ST52160WC

Specifications summary table

The following table serves as a quick reference for the drives' performance specifications. These and other specifications are discussed in the Specifications summary section following the table.

Drive specification	ST52160N	ST52160WC
Guaranteed capacity (Gbytes, 10^9)	2.17	2.17
Guaranteed sectors	4,238,282	4,238,282
Bytes per sector	512	512
Sectors per track (average)	161	161
Physical cylinders	6,536	6,536
Physical read/write heads	4	4
Discs	2	2
Recording density (bits per inch, max)	122,369	122,369
Track density (tracks per inch)	6,731	6,731
Spindle speed (RPM)	5,397 ± 0.5%	5,397 ± 0.5%
Internal data-transfer rate (Mbits per second max)	56.3 to 99.6 MHz	56.3 to 99.6 MHz
External transfer rate (Mbytes per second, max)	10.0 asynchronus 20.0 synchronous	20.0 asynchronus 40.0 synchronous
Cache buffer (Kbytes)	128	256
Height, inches max (mm)	0.748 (19.0)	0.748 (19.0)
Width, inches max (mm)	4.01 (101.8)	4.01 (101.8)
Depth, inches max (mm)	5.38 (136.6)	5.38 (136.6)
Typical weight, lb. (Kg)	1.0 (0.45)	1.0. (0.45)
Track-to-track seek time (msec, typical)	3.5	3.5
Average seek time (msec, typical)	11.0	11.0
Average seek time read (msec, typical)	12.0	12.0
Average seek time write (msec, typical)	13.0	13.0
Full-stroke seek time (msec, typical)	25.0	25.0
Average latency (msec)	5.56	5.56
Power-on to ready (sec, typical)	20	20
Spinup current: +12V (max)	1.18A	1.18A
Seek power (typical)	6.4W	6.4W

Drive specification	**ST52160N**	**ST52160WC**
Read/Write power (typical)	6.3W	6.3W
Idle power (typical)	6.2W	6.2W
Voltage tolerance (including noise): +5V	± 5%	± 5%
Voltage tolerance (including noise): +12V	± 5%	± 5%
Ambient temperature, operating (C°)	5° to 55°C	5° to 55°C
Temperature gradient, operating (°C per hour max)	20°C	20°C
Relative humidity,operating gradient (max)	10% per hr.	10% per hr.
Relative humidity, operating	8% to 80%	8% to 80%
Wet bulb temperature operating (noncondensing)	29.4°C	29.4°C
Altitude, operating	–1,000 to 10,000 ft.	–1,000 to 10,000 ft.
Shock, normal operating (Gs max for 11 msec)	2 Gs	2 Gs
Vibration, operating (Gs max at 22–350 Hz without nonrecoverable errors)	0.75 Gs 0 to Peak	0.75 Gs 0 to Peak
Vibration, nonoperating (Gs max at 22–350 Hz with no physical damage incurred)	4 Gs 0 to Peak	4 Gs 0 to Peak
Nonrecoverable read errors (bits transferred)	1 per 10^{13}	1 per 10^{13}
Mean time between failures (MTBF) (power-on hours)	500,000	500,000
Contact start-stop cycles	50,000	50,000
Service life (years)	5	5

1.0 Specifications summary

1.1 Formatted capacity

The capacities specified here do not include spare sectors and cylinders. The media contains 2,000 spare blocks at the end of the volume.

Guaranteed capacity (Gbytes[3])	2.17
Guaranteed sectors	4,238,282

1.2 Physical geometry

Discs	2
Read/write heads	4
Cylinders	6,536
Sectors per track (average)	161

1.3 Functional specifications

Interface	SCSI-3 SPI Compliant
PRML recording method	Code (0,4,4)
External data-transfer rate (Mbytes per sec, max)	10 asynchronous[4] 20 synchronous[4] 20 asynchronous[5] 40 synchronous[5]
Internal data-transfer rate (Mbits per sec)	56.3 - 99.6 MHz
Bytes per sector	512
Data zones	19
Areal density (Mbits/ in^2)	823.7
Track density (TPI)	6,731
Recording density (BPI, max)	122,369

3. One Gbyte equals 1,000,000,000 bytes.

4. ST52160N

5. ST52160WC

1.4 Physical dimensions

Height (max)	0.748 inches (19 mm)
Width (max)	4.01 inches (101.8 mm)
Depth (max)	5.38 inches (136.6 mm)
Weight (max)	1.0 lb. (0.45 Kg)

1.5 Seek time

All seek time measurements are taken under nominal conditions of temperature and voltage with the drive mounted horizontally. In the following table:

- *Track-to-track* seek time is the average of all possible single-track seeks in both directions.
- *Average/typical* seek time is a true statistical random average of at least 5,000 measurements of seeks in both directions between random cylinders, less overhead.
- *Full-stroke* seek time is one-half the time needed to seek from logical block address zero (LBA 0) to the maximum LBA and back to LBA 0.

Track-to-track seek time typ[6]	**Average/typical seek time[7]**	**Full-stroke seek time typ[8]**	**Average latency**
3.5 msec typ	11.0 msec typ	25.0 msec typ	5.56 msec
4.5 msec max	12.0 msec read	27.0 msec max	
	13.0 msec write		

Note. Host overhead varies between systems and cannot be specified. Drive internal overhead is measured by issuing a no-motion seek. Drive overhead is typically less than 1.0 msec.

---

6. All possible one- track seeks are divided into the time required to perform these seeks. Only the mechanism time is used; interface overhead is excluded.

7. All possible seeks are divided into the time required to perform these seeks. Only the mechanism time is used; interface overhead is excluded.

8. The average of 1,000 full-stroke seeks is used in this computation. Only the mechanism time is used; interface overhead is excluded.

1.6 Read look-ahead and caching

The drives use algorithims that improve seek performance by storing data in a buffer and processing it at a more convenient time. Three methods are used: read look-ahead, read caching and write caching. These are described in Appendix C.6 on page 108.

1.7 Start/stop command

If the motor-start option is disabled, the drive is ready within 20 seconds after power is applied. If the motor-start option is enabled, the drive is ready within 20 seconds after it receives the Motor Start command. If the drive receives a command to spin down or power is removed, the drive stops within 15 seconds.

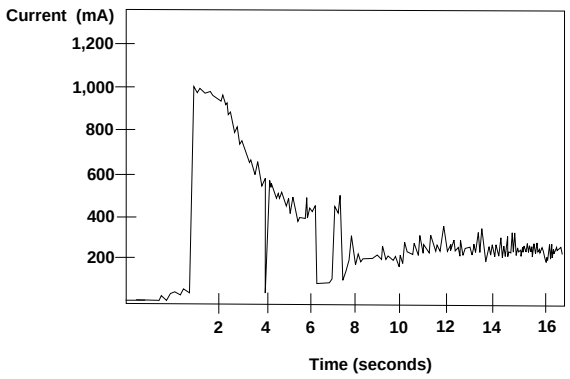


Figure 1. Typical startup current profile

1.7.1 Power-up sequence

The following typical power-up sequence is provided to assist you in evaluating drive performance. This information does not constitute a specification or a performance guarantee.

1. Power is applied to the disc drive.

2. Depending on whether there is a jumper installed on pins 9 and 10 of the options jumper block (J5) shown in Figure 3 on page 19, either of the following sequences occurs:

- If a jumper is not installed, the remote start option is not enabled, and the drive begins to spin up as soon as power is applied.
- If a jumper is installed, the remote start option is enabled, and the drive begins to spin up when the host sends a command for the motor to start.

3. Within 250 msec after power is applied, the drive responds to the Test Unit Ready, Request Sense, Mode Sense and Inquiry commands.

4. The drive begins to lock in speed-control circuits.

6. The actuator lock releases the actuator.

7. The spindle motor reaches operating speed in about 5 seconds. After 5 seconds, there are no speed variations.

8. The drive performs velocity-adjustment seeks.

9. The drive seeks track 0 and is then ready.

1.7.2 Power-down sequence

Caution. Do not move the drive until the motor has come to a complete stop.

1. The power is turned off.

2. Within 15 seconds, the drive spindle stops rotating.

3. The read/write heads automatically move to the landing zone, which is inside the maximum data cylinder.

4. The magnetic acuator lock mechanism locks the arm. This completes the power-down sequence.

1.7.3 Auto-park

During power-down, the read/write heads automatically move to the landing zone. The heads park inside the maximum data cylinder and the magnetic actuator lock engages. When power is applied, the heads recalibrate to track 0.

1.8 Power management

The drive supports power-management modes that reduce its overall power consumption. They automatically change from one mode to another in response to interface activity. You do not need to change any parameters or send any special commands to make the drive change modes. The power-management modes are described as follows:

- **Spinup.** Spinup is defined as the period during which the spindle is coming up to operating speed. The power consumed in this mode is equivalent to the average power during the first 10 seconds after the drive begins to spin up.

- **Seek.** The servo electronics are active, and the heads are moving to a specific location on the disc. The read/write electronics are powered-down. The power consumed in this mode is equivalent to the average power measured while executing random seeks with a 2-revolution (26.6 msec) dwell between seeks. The drive enters this mode from the Idle mode.
- **Read/Write.** The drive is reading or writing. All electronics are active and the heads are on track.
- **Idle.** The motor is up to speed and the drive is in track-follow mode.

1.8.1 Power consumption

Values in the table below were measured at the drive power connector with an RMS DC ammeter. The terminating resistors are disabled, and terminator power is supplied through the SCSI connector. All values are measured 10 minutes after the drive spins up except as noted.

	Spinup	Seeking	Read/ Write	Idle	Standby
Current at +12V					
Amps peak	1.18	—	—	—	—
RMS amps typ	—	0.287	0.274	0.274	0.020
Watts typ	—	3.444	3.288	3.288	0.240
Current at +12V					
RMS amps typ	—	0.596	.0.590	0.581	0.625
Watts typ	—	2.980	2.950	2.905	3.125
Power					
Total watts typ	—	6.424W	6.238W	6.193W	3.365W

1.8.2 Voltage tolerance

	+5V	+12V
Voltage tolerance (including noise)	± 5%	± 5%

1.8.3 Input noise

	+5V	+12V
Voltage tolerance (including noise)	± 5%	± 5%
Input noise frequency (max)	25 MHz	25 MHz
Input noise (max, peak-to-peak)	100 mV	240 mV

1.9 Environmental

This section specifies acceptable environmental conditions for the drives. The operating specifications assume that the drive is powered up. The nonoperating specifications assume that the drive is packaged as it was shipped from the factory.

1.9.1 Ambient temperature (HDA case)

Operating	5°C to 55°C (41°F to 131°F)
Nonoperating	–40°C to 70°C (–40°F to 158°F)

Note. The system must provide sufficient airflow so that the aluminum base surface temperature remains below 55°C.

1.9.2 Temperature gradient

Operating	20°C per hour (36°F per hour)
Nonoperating	30°C per hour (54°F per hour)

1.9.3 Altitude

Operating	–1,000 ft. to 10,000 ft. (–305 m to 3,048 m)
Nonoperating	–1,000 ft. to 40,000 ft. (–305 m to 12,192 m)

1.9.4 Relative humidity

Operating	8% to 80% noncondensing Maximum wet bulb 29.4°C (84.9°F)
Operating gradient, max	10% per hour
Nonoperating	5% to 95% noncondensing Maximum wet bulb 35°C (95.0°F)

1.10 Shock and vibration

All shock and vibration specifications assume that the inputs are measured at the drive mounting screws. Shock measurements are based on an 11-msec, half sine wave shock pulse, not to be repeated more than twice per second.

During normal operating shock and vibration, there is no physical damage to the drive or performance degradation.

During abnormal operating shock and vibration, there is no physical damage to the drive, although performance may be degraded during the shock or vibration episode. When normal operating shock levels resume, the drive meets its performance specifications.

During nonoperating shock and vibration, the read/write heads are positioned in the shipping zone.

	Normal operating	**Abnormal operating**	**Nonoperating**
Shock	2 Gs	10 Gs	75 Gs
5–22 Hz vibration	0.020-inch displacement	0.030-inch displacement	0.160-inch displacement
22–350 Hz vibration	0.50 Gs	0.75 Gs	4.00 Gs

1.11 Acoustics

This table shows the overall A-weighted sound power and sound pressure levels for the drives. All measurements are generally consistent with ISO document 7779. Acoustic measurements are taken under essentially free-field conditions over a reflecting plane. The drive is oriented with the top cover up for all tests.

Overall A-weighted Value	**Idle**	**Seek**
Sound power, typ (bels)	3.4	4.0
Sound power, max (bels)	3.7	4.3
Sound pressure, typ (dBA)	27	30
Sound pressure, max (dBA)	30	33

1.12 Reliability

Read error rates are measured with automatic retries and data correction with ECC enabled and all flaws reallocated. The mean time between failures (MTBF) is measured at nominal power at sea level and an ambient temperature of 35°C.

Nonrecoverable read errors	1 per 10^{13} bits transferred
Seek errors	1 per 10^{7} physical seeks
Contact stops and starts	50,000
MTBF	500,000 power-on hours
Service life	5 years

1.13 Agency listings

These drives are listed by agencies as follows:

- Recognized in accordance with UL 478 and UL 1950
- Certified to CSA C22.2 No. 220-M1986 and CSA C22.2 No. 950-M1989
- Certified to VDE 0806/05.90 and EN 60950/1.88 as tested by VDE

1.14 Electromagnetic Compliance for the European Union

This model has the CE Marking, signifying that it complies with the European Union requirements of the Electromagnetic Compatibility Directive 89/336/EEC of 03 May 1989 as amended by Directive 92/31/EEC of 28 April 1992 and Directive 93/68/EEC of 22 July 1993.

Seagate® uses an independent laboratory to confirm compliance to the above directives. The drive was tested in a representative system for typical applications. The selected system represents the most popular characteristics for test platforms.

The system configurations include:

- 486, Pentium, and PowerPC microprocessors
- 3.5-inch floppy disc drive
- Keyboard
- Monitor/display

Although the test system with this Seagate model complies to the directives, we cannot guarantee that all systems will comply. The computer manufacturer or system integrator will confirm EMC compliance and provide CE Marking for their product. The drive is not meant for external uses (without properly designed enclosure, shielded I/O cable, etc.), and a terminator should be used on all unused I/O ports.

1.15 FCC verification

The Medalist Pro SCSI interface drives are intended to be contained solely within a personal computer or similar enclosure (not attached to an external device). As such, a drive is considered to be a subassembly even when individually marketed to the customer. As a subassembly, no Federal Communications Commission authorization, verification or certification of the device is required.

Seagate Technology, Inc. has tested the drive in an enclosure as described above to ensure that the total assembly (enclosure, disc drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of the FCC rules. Operation with noncertified assemblies is likely to result in interference to radio and television reception.

Radio and television interference. This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television, which can be determined by turning the equipment on and off, you are encouraged to try one or more of the following corrective measures:

- Reorient the receiving antenna.
- Move the device to one side or the other of the radio or TV.
- Move the device farther away from the radio or TV.
- Plug the equipment into a different outlet so that the receiver and computer are on different branch outlets.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems.* This booklet is available from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

Note. This digital apparatus does not exceed the Class B limits for radio noise emissions from computer equipment as set out in the radio interference regulations of the Canadian Department of communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

Sicherheitsanleitung

1. Das Gerrät ist ein Einbaugerät, das für eine maximale Umgebungstemperatur von 55℃ vorgesehen ist.

2. Zur Befestigung des Laufwerks werden 4 Schrauben 6-32 UNC-2A benötigt. Bei seitlicher Befestigung darf die maximale Länge der Schrauben im Chassis nicht mehr als 5,08 mm und bei Befestigung an der Unterseite nicht mehr als 5,08 mm betragen.

3. Als Versorgungsspannugen werden benötigt:
+5V æ 5% 0.55A
+12V æ 5% 0.35A (1,9A fur ca. 10 Sek. fur ± 10%)

4. Die Versorgungsspannung muss SELV entsprechen.

5. Alle Arbeiten an der Festplatte dürfen nur von ausgebildetem Servicepersonal durchgeführt werden. Bitte entfernen Sie nicht die Aufschriftenschilder des Laufwerkes.

6. Der Einbau des Laufwerkes muss den Anforderungen gemäss DIN IEC 950 VDE 0805/05.90 entsprechen.

2.0 Hardware and interface

The Medalist Pro drives use an UltraSCSI interface. The ST52160N consists of an 8-bit bidirectional data bus. The ST52160WC consists of a 16-bit bidirectional data bus. The interface supports multiple initiators, disconnect and reconnect, self-configuring host software and logical block addressing.

The UltraSCSI interface uses a singled-ended driver/receiver configuration that uses asynchronous or synchronous communication protocols. The ST52160N supports asynchronous transfer rates up to 10 Mbytes per second and synchronous transfer rates up to 20.0 Mbytes per second. The ST52160WC supports asynchronous transfer rates up to 20 Mbytes per second and synchronous transfer rates up to 40 Mbytes per second.

2.1 SCSI-3 compatibility

The drive interface is described in the Seagate SCSI-2 /SCSI-3 Interface Manual, publication number 77738479. The drives comply with the mandatory subset of the ANSI SCSI-2 Interface. The Fast SCSI-3 interface is based on the ANSI Small Computer System Interface-2 (SCSI-2), document number ANSI X3.131-1994.

2.2 Handling and static-discharge precautions

The drive has static-sensitive devices. Avoid damaging the drive and these devices by observing the following standard handling and static-discharge precautions:

- Keep the drive in its static-shielded bag until you are ready to complete the installation. Do not attach any cables to the drive while it is in its static-shielded bag.
- Before handling the drive, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.

  Wool and synthetic clothes, carpets, plastics and Styrofoam contributes to electrostatic buildup. Static discharge may damage sensitive components in your drive and computer.
- Handle the drive by its edges or frame only.
- The drive is extremely fragile—handle it with care. Do not press down on the drive's top cover.

- Always rest the drive on a padded, antistatic surface until you mount it in the host system.
- Do not touch the connector pins or the printed circuit board.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. If you do, you void the warranty. Some factory-installed labels contain information needed to service the drive. Others are used to seal out dirt and contamination.

2.3 Electrical interface

The drives are designed to use single-ended interface signals. They use single-ended drivers and receivers and active terminator circuitry. Figure 2 shows a single-ended transmitter and receiver without the active terminator circuitry.

- **Transmitter characteristics.** The drives use an ANSI SCSI-compatible, open-collector, single-ended driver. This driver is capable of sinking a current of 48 mA with a low-level output voltage of 0.4 volts.
- **Receiver characteristics.** The drives use an ANSI SCSI single-ended receiver with hysteresis gate or equivalent as a line receiver.

The loss in the cable is defined as the difference between the voltages of the input and output signals, as shown below:

Logic level	Driver output (x)	Receiver input (x)
Asserted (1)	$0.0V \leq x \leq 0.4V$	$0.0V \leq x \leq 0.8V$
Negated (0)	$2.5V \leq x \leq 5.25V$	$2.0V \leq x \leq 5.25V$

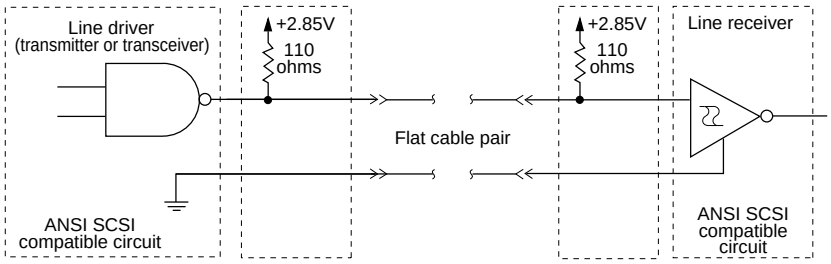


Figure 2. Single-ended transmitter and receiver

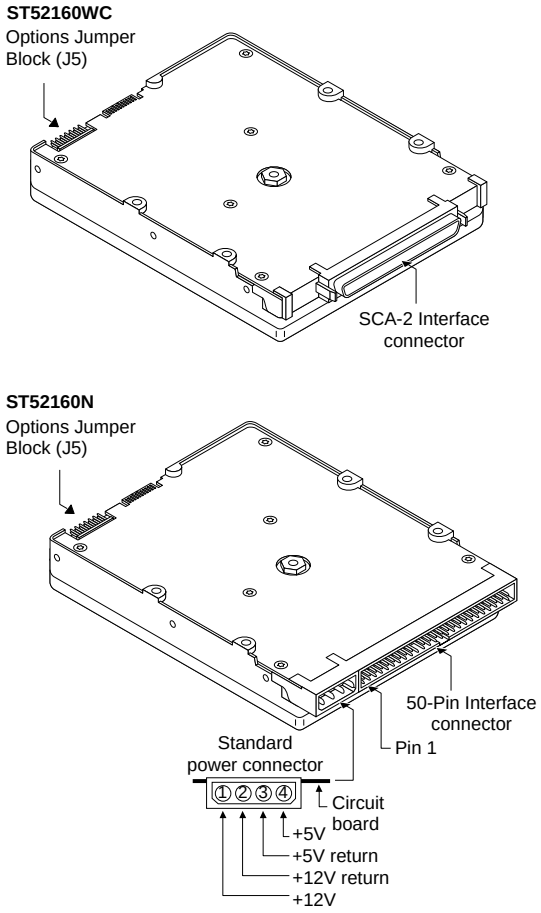


Figure 3. Connectors

2.4 Interface and connector configuration

The ST52160N and ST52160WC drives are differentiated by their connectors. The ST52160N comes with a standard 50-pin interface connector and a standard 4-pin power connector. The ST52160WC comes with an 80-pin blindmate single-connector attachment (SCA-2). The power is supplied to the drive through the bus. To minimize noise, use shielded mating connectors.

2.5 ST52160N interface connector

The ST52160N uses a standard 50-pin, nonshielded, keyed connector. The connector consists of two rows of 25 male contacts 0.100 inches apart. Pin 1 on the connector is shown in Figure 3 on page 19. Recommended mating connectors and their part numbers are

listed below.

Part numbers for mating 3M connectors that are compatible with the drives are listed below. These connectors do not have a center key and are available with or without strain relief.

	Without strain relief No center key	**With strain relief No center key**
Closed end (for cable ends)	3M 3425-7000	3M 3425-7050
Open end (for daisy chain)	3M 3425-6000	3M 3425-6050

Part numbers for mating Molex connectors compatible with the drives are listed below. These connectors have a center key.

Closed end (for cable ends)	Molex 39-51-2504
Open end (for daisy chain)	Molex 39-51-2501

Below are part numbers for strain reliefs that can be used with the Molex connectors.

Molex strain relief, preferred version in Europe	Molex 90170-0050
Molex strain relief, preferred version in Japan	Molex 15-25-1503

2.5.1 ST52160N interface pin assignments

The table below shows the pin assignment for the ST52160N 50-pin interface connector. A minus sign (–) indicates an active-low signal.

Signal name	Signal pin number	Ground pin number
–DB(0)	2	1
–DB(1)	4	3
–DB(2)	6	5
–DB(3)	8	7
–DB(4)	10	9
–DB(5)	12	11
–DB(6)	14	13
–DB(7)	16	15
–DB(P)	18	17
Ground	19–22	—
Reserved	23–25	—
Terminator power	26	—
Reserved	27–28	—
Ground	29–30	—
–ATN	32	31
Ground	33–34	—
–BSY	36	35
–ACK	38	37
–RST	40	39
–MSG	42	41
–SEL	44	43
–C/D	46	45
–REQ	48	47
–I/O	50	49

Caution. Do not connect pin 25 to ground. If you plug in the connector upside down, the terminator power on pin 26 is shorted to ground. This may damage the drive.

2.5.2 ST52160WC interface connector

The ST52160WC uses an 80-pin blindmate single-connector attachment (SCA-2). It is a single-piece connector that provides power to the drive through the SCSI bus. The remote LED, motor start options and additional binary codes are also placed on the SCSI bus. Pin 1 on the connector is shown in Figure 3 on page 19.

We recommend the AMP blindmate receptacle assembly (part number 787311-1).

2.5.3 ST52160WC interface pin assignments

The following table shows the pin assignments for the ST52160WC 80-pin interface connector. A minus sign (–) indicates an active-low signal.

Signal Name (1)	Connector Contact Number (3)	Cable Conductor (2)		Connector Contact Number (3)	Signal Name (1)
+12V	1	1	2	41	12V GND
+12V	2	3	4	42	12V GND
+12V	3	5	6	43	12V GND
+12V	4	7	8	44	Mated 1
NC (9)	5	9	10	45	NC (9)
NC (9)	6	11	12	46	GND (7)
–DB11	7	13	14	47	GND
–DB10	8	15	16	48	GND
–DB9	9	17	18	49	GND
–DB8	10	19	20	50	GND
–I/O	11	21	22	51	GND
–REQ	12	23	24	52	GND
–C/D	13	25	26	53	GND
–SEL	14	27	28	54	GND
–MSG	15	29	30	55	GND
–RST	16	31	32	56	GND
–ACK	17	33	34	57	GND
–BSY	18	35	36	58	GND

Signal Name (1)	Connector Contact Number (3)	Cable Conductor (2)		Connector Contact Number (3)	Signal Name (1)
–ATN	19	37	38	59	GND
–DBP	20	39	40	60	GND
–DB7	21	41	42	61	GND
–DB6	22	43	44	62	GND
–DB5	23	45	46	63	GND
–DB4	24	47	48	64	GND
–DB3	25	49	50	65	GND
–DB2	26	51	52	66	GND
–DB1	27	53	54	67	GND
–DB0	28	55	56	68	GND
–DP1	29	57	58	69	GND
–DB15	30	59	60	70	GND
–DB14	31	61	62	71	GND
–DB13	32	63	64	72	GND
–DB12	33	65	66	73	GND
+5 V	34	67	68	74	Mated 2
+5 V	35	69	70	75	5V GND
+5 V	36	71	72	76	5V GND
NC (9)	37	73	74	77	Active LED out (4) (8)
RMT-START (6) (8)	38	75	76	78	DLYD-Start (9)
SCSI ID 0 (6) (8)	39	77	78	79	SCSI ID 1 (6) (8)
SCSI ID 2 (5) (8)	40	79	80	80	SCSI ID 3 (6) (8)

Notes:

1. See Section 2.3 on page 18 for detailed electrical characteristics of these signals.
2. The conductor number refers to the conductor position when using 0.025-inch (0.635 mm) centerline flat-ribbon cables. You can use other cable types to implement equivalent contact assignments.
3. Connector contacts are on 0.050 inch (1.27 mm) centers.
4. Front-panel LED signal: indicates drive activity for the front-panel hard drive activity indicator.
5. Asserted by the host to enable the Motor Start option (Motor Start enables the motor through the SCSI bus command).
6. To set up the SCSI bus ID on the drive, the host asserts the binary code on A3, A2, A1 and A0.
7. GND provides a means for differential devices to detect the presence of a single-ended device on the bus.
8. Refer to notes 4 through 7 instead of installing jumpers and cables on the options jumper block (J5).
9. NC means no connection.
10. The conductor number refers to the conductor position when using 0.050 inch (1.27 mm) centerline flat ribbon cables. You can use other cable types to implement equivalent assignments.
11. Connector contacts are on 0.100 inch (2.54 mm) centers.

2.6 Interface cable requirements

A characteristic impedance of 100 ohms + 10% is recommended for the unshielded flat or twisted-pair interface cable. However, most available cables have a somewhat lower characteristic impedance. To minimize discontinuities and signal reflections, do not use cables of different impedances on the same bus. If shielded and unshielded cables are mixed within the same bus, the effect of impedance mismatch must be carefully considered. This is especially important for maintaining adequate margins for UltraSCSI transfer rates. UltraSCSI implementation may require adjustments to cable length, the number of loads and the transfer rates to achieve satisfactory system operation.

Part	**Manufacturer**
Flat Cable	3M-3365-50
Twisted Pair	Spectra Twist-N-Flat 455-248-50

2.6.1 Interface cable length for asynchronous operation

The SCSI interface cable must meet the following requirements for normal operation:

- The cable length cannot be longer than 6.0 meters.
- Cable stubs cannot be more than 0.1 meter long and must be separated by at least 0.3 meter.

2.6.2 Interface cable for Fast SCSI operation

When using Fast SCSI synchronous data-transfer rates, the SCSI interface cable must meet the following additional requirements:

- The cable length cannot be longer than 3.0 meters.
- The cable should not attenuate a 5-MHz signal more than 0.095 dB per meter.
- The DC resistance at 20°C must not exceed 0.230 ohms per meter.
- A shielded, twisted-pair cable should not have a propagation delay delta greater than 20 nsec per meter.

2.6.3 Interface cable for UltraSCSI operation

- The cable cannot be longer than 3.0 meters when using up to 4 devices.

- The maximum cable length when using 5 to 8 devices cannot be longer than 1.5 meters.
- Cable stubs cannot be more than 0.1 meter long and must be separated by at least 0.3 meter.

2.7 Options jumper block

The ST52160N and ST52160WC options jumper block allows you to:

- Set the SCSI ID address.
- Enable or disable active termination.
- Enable parity.
- Activate the motor start/stop option.
- Attach a remote LED.

These functions are represented on the drives' options jumper block (J5). Figure 4 and Figure 5 on pages 27 and 28 show you how to configure the jumpers. The ST52160WC allows you to configure some of these functions through the SCSI bus. You must use either the bus commands or the jumpers to configure the drive when both options are available.

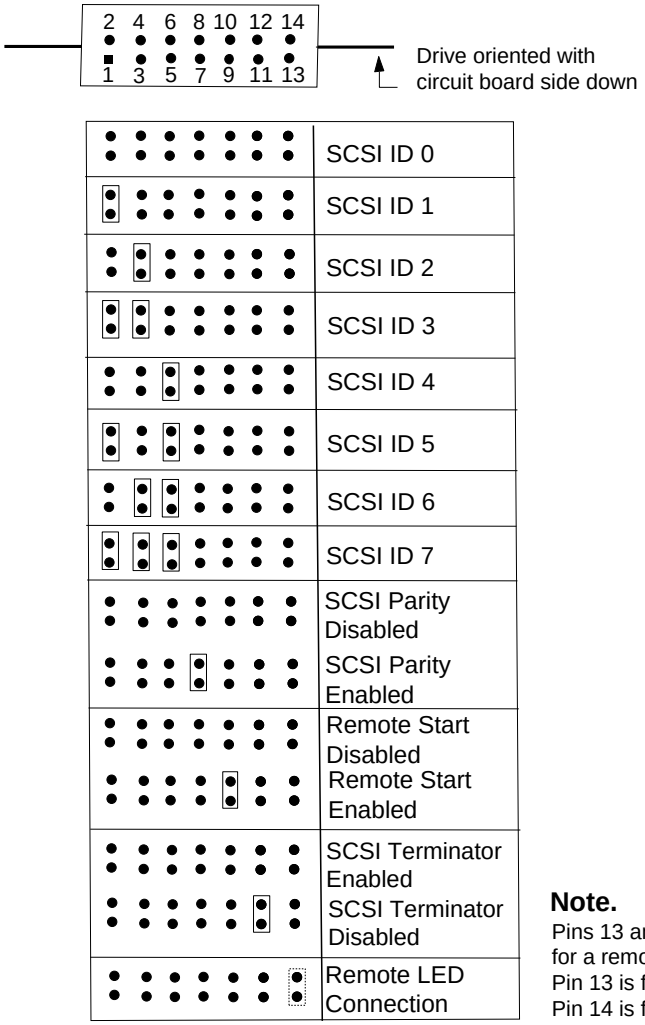
The options jumper block accepts 2-mm jumpers. If you need additional jumpers, use the jumpers listed below or equivalent.

Manufacturer	**Part number**
Seagate	13211-001
Du Pont	89133-001
Methode	8618-202-70

2.7.1 SCSI address

The SCSI ID address is set using pins 1 and 2, 3 and 4, and 5 and 6 on the options jumper block (J5). The drive is shipped with no jumpers on the SCSI addresses. This makes the default SCSI ID 0. To configure the drive for a different address, consult the charts in Figure 4 or Figure 5 on pages 27 and 28. Refer to your host adapter manual for the preferred addressing scheme.

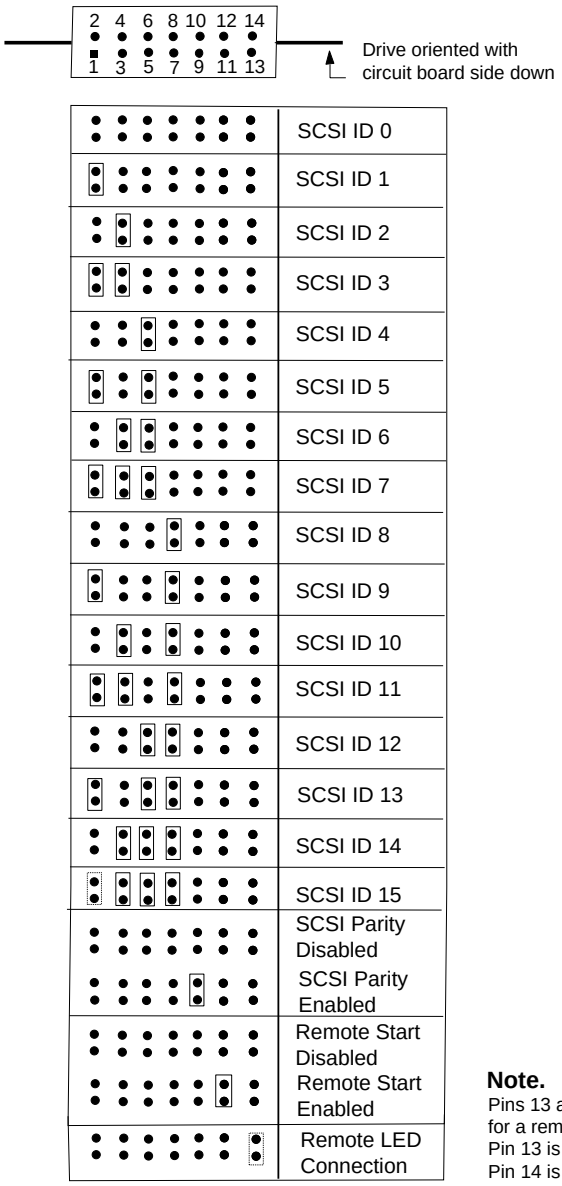
ST52160N Options jumper block (J5)



Note.
Pins 13 and 14 are used for a remote LED connection. Pin 13 is for cathode and Pin 14 is for anode.

Figure 4. ST52160N jumper settings

ST52160WC Options jumper block (J5)



Note.
Pins 13 and 14 are used for a remote LED connection. Pin 13 is for cathode and Pin 14 is for anode.

Figure 5. ST52160WC jumper settings

2.8 Active Termination

Active termination is configured on the ST52160N using pins 11 and 12 on the J5 options jumper block. Active termination is enabled when there is no jumper on pins 11 and 12. Active termination is disabled when a jumper is placed on pins 11 and 12. The drive provides termination power to the drive's terminator chips and to the SCSI bus. No other option is available.

Termination is not provided on the ST52160WC. You must provide your own external termination as required.

2.9 Parity enable option

Parity is enabled on the ST52160N when a jumper is installed on pins 7 and 8 of the options jumper block (J5). Parity is enabled on the ST52160WC when a jumper is installed on pins 9 and 10 of the options jumper block (J5). Both drives are shipped with parity enabled.

2.9.1 Motor Start option

The Motor Start option causes the drive to wait for a Start/Stop Unit command from the host before starting or stopping the spindle motor. Motor Start is enabled on the ST52160N when a jumper is installed on pins 9 and 10 of the options jumper block (J5). Motor Start is enabled on the ST52160WC when a jumper is installed on pins 11 and 12 of the options jumper block (J5).

2.9.2 Remote LED connection

Pins 13 and 14, located on the options jumper block, are reserved for a remote LED. Pin 13 is ground. The options jumper block accepts 2-mm connectors. You may need to replace the current LED cable-connector with a 2-mm connector. If you are placing the drive in an array configuration, we recommend the LiteOn (part number LTL-3231A) LED or equivalent.

2.10 Daisy chaining

You can connect the ST52160N in a daisy-chain configuration with a maximum of eight SCSI devices (host included) that have single-ended drivers and receivers. Each SCSI device must be set to a unique SCSI ID number. SCSI ID 7 is usually used by the host adapter.

Devices at both ends of the SCSI bus must be terminated; intermediate devices should not be terminated. All electrical signals are common between all SCSI devices.

2.11 Hot-plugging

Hot-plugging allows you to connect and disconnect the I/O and power cables for each SCSI device in a daisy chain without powering down the system. When hot-plugging, the following conditions must be met:

- All I/O transactions are complete before you install or remove a drive.
- The terminators at either end of the SCSI bus are in place.
- The drive you are disconnecting or connecting is not the device that supplies terminator power or terminator resistance to the bus.

To avoid damage to the head/disc assembly, the spindle motor must be completely stopped and the heads must be parked before before you remove the drive from the system. You can stop the spindle and park the heads as follows:

- If the drive is not configured to use the remote start/stop feature, disconnect the DC power cable from the drive DC power connector and wait 30 seconds.
- If the drive is configured to use the remote start/stop feature, issue the Start/Stop Unit command and wait 30 seconds.

2.12 Mounting the drive

The drives fit the standard 3.5-inch form-factor but have a 0.75-inch height profile and a 5.38-inch depth profile. You can mount them securely in the computer using either the bottom or side mounting holes, as described below. Position the drive so that you do not strain or crimp the cables. Refer to Figure 6 and Figure 7 on pages 32 and 33 for the mounting dimensions

Bottom mounting holes. Insert 6-32 UNC-2A mounting screws in the four available bottom mounting holes. Do not insert the screws more than 0.20 inches (6 turns) into the drive frame.

Side mounting holes. Insert 6-32 UNC-2A mounting screws in four of the six available side mounting holes. Use two mounting holes on each side of the drive. Do not insert the screws more than 0.20 inches (6 turns) into the drive frame.

Caution. To avoid damaging the drive:

- Use only mounting screws of the type specified.
- Gently tighten the mounting screws—do not apply more than 6 inch-lb of torque.

In the following figures, all dimensions are in inches and millimeters (mm).

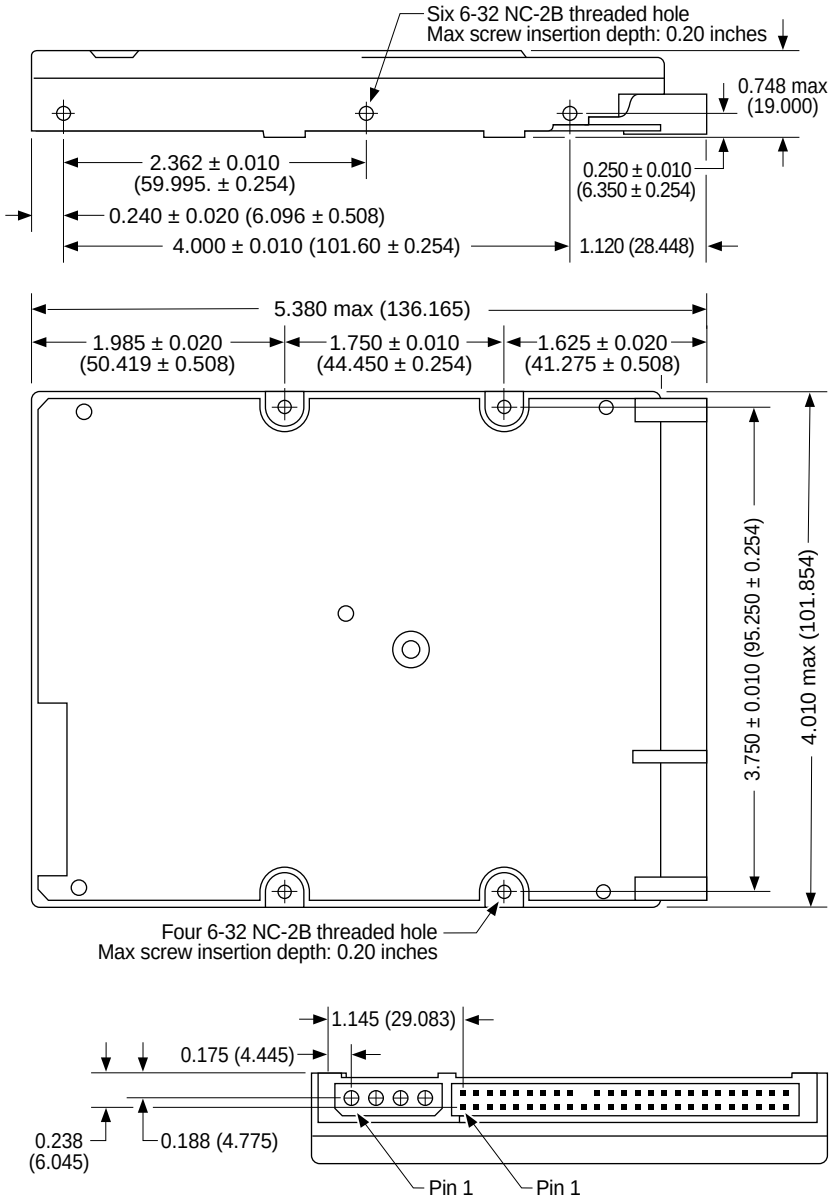


Figure 6. ST52160N Mounting dimensions

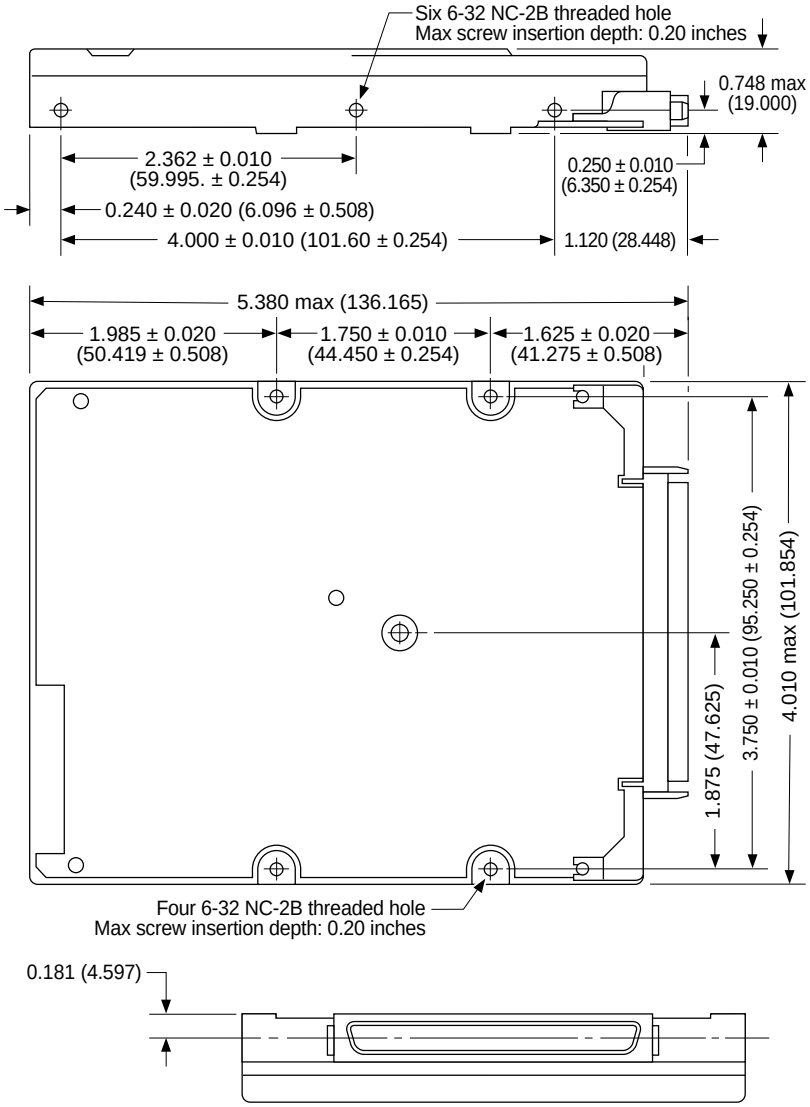


Figure 7. ST52160WC Mounting dimensions

3.0 Command set

The drives support a subset of the Group 0, Group 1 and Group 2 standard SCSI commands. The commands are described in this section.

3.1 Command descriptor block

The initiator makes a request to the drive by sending a command descriptor block (CDB) to the drive. Each CDB has the following common characteristics:

- Byte 0 always contains the operation code.
- The three most significant bits (bits 7–5) of byte 1 contain the logical unit number (LUN). This field is ignored if an Identify Message is sent.
- The last byte is always zero.

3.2 Status byte

The drive terminates each command by sending the status byte (shown below) to the initiator during the status phase before the command complete message.

<table>
<tr><th rowspan="2">Bytes</th><th colspan="8">Bits</th></tr>
<tr><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td rowspan="2">0</td><td colspan="2">Reserved</td><td colspan="5" rowspan="2">Status byte code</td><td>Rsvd</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
</table>

The *status byte* can be any of the following:

00_H **Good status.** The drive has successfully completed a command.

02_H **Check condition status.** The drive detected an error, an exception or an abnormal condition. In response, the initiator may issue a Request Sense command to determine the nature of the condition.

08_H **Busy status.** The drive is busy and is unable to accept a command from an initiator. The initiator retries the command later. The drive returns a busy status if 1) the initiator has not sent the disconnect message and tries to queue a command or 2) the initiator rejects the disconnect message and the queue is not empty.

18_H Reservation conflict status. A SCSI device tried to access the drive, but was unable to because the drive was already reserved by another SCSI device.

28_H Queue full status. The drive received a command but rejected it because the queue was full. The drive only uses this status if tagged command queuing is implemented.

3.3 Supported commands

The drive supports the commands listed below.

Group 0 commands	**Operation code**
Test Unit Ready	00_H
Rezero Unit	01_H
Request Sense	03_H
Format Unit	04_H
Reassign Blocks	07_H
Read (6)	08_H
Write (6)	$0A_H$
Seek (6)	$0B_H$
Inquiry	12_H
Mode Select (6)	15_H
Reserve (6)	16_H
Release (6)	17_H
Mode Sense (6)	$1A_H$
Start/Stop Unit	$1B_H$
Receive Diagnostic Results	$1C_H$
Send Diagnostic	$1D_H$

Group 1 commands	**Operation code**
Read Capacity	25_H
Read (10)	28_H
Write (10)	$2A_H$
Seek (10)	$2B_H$
Write and Verify	$2E_H$

Group 1 commands	Operation code
Verify	$2F_H$
Read Defect Data	37_H
Write Data Buffer	$3B_H$
Read Data Buffer	$3C_H$
Read Long	$3E_H$
Write Long	$3F_H$
Group 2 commands	
Log Select	$4C_H$
Log Sense	$4D_H$
Reserve (10)	56_H
Release (10)	57_H

3.4 Group 0 commands

3.4.1 Test Unit Ready command (00_H)

The Test Unit Ready command verifies that the drive is ready; it is not a request for a self-test. If the drive can accept an appropriate media access command without encountering an error, it returns a good status.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	LUN			0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0

3.4.2 Rezero Unit command (01_H)

The Rezero Unit command retracts the read/write heads to the cylinder containing logical block zero.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	1
1	LUN			0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0

3.4.3 Request Sense command (03_H)

The Request Sense command requests the drive to transfer sense data to the initiator in the additional sense data format. The additional sense format is described in Appendix B on page 91.

The sense data applies to the previous command on which a check condition status was returned. This sense data is saved for the initiator until:

- The initiator requests the sense data using the Request Sense command, or
- Another command is received from the initiator that issued the original command that caused the check condition status.

If any of the following fatal errors occur during a Request Sense command, the drive sends a check condition status, and the sense data may be invalid.

- The drive receives a nonzero reserved bit in the CDB.
- An unrecovered parity error occurs on the data bus.
- A malfunction prevents return of sense data.

If any other error occurs during the Request Sense command, the drive returns sense data with a good status.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	1	1
1	LUN			0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Allocation length							
5	0	0	0	0	0	0	0	0

Byte 4 The *allocation length* specifies the maximum number of bytes the initiator has allocated for returned sense data. The drive returns the number of bytes specified by the allocation length up to 22 bytes. If the allocation length is set to zero, no sense data is returned. *This is not an error.*

3.4.4 Format Unit command (04_H)

The Format Unit command assures that the medium is formatted so that all of the addressable data blocks can be accessed. In addition, the medium can be certified and control structures may be created for the management of the medium and defects.

If the specified logical unit is reserved, the Format Unit command is rejected with a reservation conflict status. Extent reservations are not supported. See Section 3.4.11 on page 51 for more information about reservations.

The initiator can specify (or not specify) sectors to be reallocated during the formatting process.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0	0
1	LUN			Fmt Data	Cmp lst	Defect list format		
2	0	0	0	0	0	0	0	0
3–4	Interleave							
5	0	0	0	0	0	0	0	0

Byte 1 The *format data* (Fmt Data) bit, the *complete list* (Cmp lst) bit, and the *Defect list format* field are described in Section 3.4.4.2. on page 40.

Bytes 3–4 The *interleave* field is not supported. It can contain any value. However, the drive always formats the disc with an interleave of 1:1.

3.4.4.1 Defect lists

When the Format Unit command is issued, media defect information can be gathered from several sources. Four of these sources—primary defect list, certification defect list, data defect list and grown defect list—are defect lists written to the drive. They are defined below. Assignments in Byte 1 of the defect list header—described in Section 3.4.4.3 on page 42, determine the use of the defect list during formatting. The Reassign Blocks and Read Defect Data commands also use these lists.

- The *primary defect list (PList)* is a list of media defects found when the drive is manufactured and written to the disc in an area that is not directly accessible by the user. These defects are considered permanent and cannot be changed.
- The *certification defect list (CList)* is a temporary list of unrecoverable sectors that the drive reads during the certify of the Format Unit command. The CList is incorporated into the GList before the end of the Format Unit command.
- The *data defect list (DList)* is a list of sectors the initiator supplies to the drive during a data-out phase of the current Format Unit command. The drive sends the DList in the last bytes of the data-out phase (described in Section 3.4.4.3) and may add it to the GList.
- The *grown defect list (GList)* is a list of defects supplied by the initiator or detected by the target but does not include defects from the PList. The GList includes defects detected by the format operation during media certification, the DList, defects previously identified with a Reassign Blocks command and defects previously detected by the target and automatically reallocated.

3.4.4.2 Format Unit parameters

For each format listed in the following table, except the default format, the initiator sends a defect list header. This header is described in Section 3.4.4.3. The physical sector format is described in Section 3.4.4.4. on page 43. The block format and bytes-from-index format are not supported.

Byte 1 of CDB					Description
Bit 4	Bit 3	Bit 2–Bit 0			
Fmt Data	Cmp Lst	Defect List Format			
0	0	X	X	X	*Default format*. The initiator does not send the defect list header or DList to the drive. The drive reallocates all sectors in the PList and GList.
0	1	X	X	X	*Format option with the PList only*. The initiator does not send the defect list header or DList to the drive. The drive reallocates all sectors in the PList and erases the GList.
1	0	0	X	X	*Extended format.* The initiator sends a defect list header but no DList. All sectors in the PList and GList are reallocated.
1	0	1	0	0	The drive does not support bytes-from-index format.
1	0	1	0	1	*Format option with the GList and DList.* The initiator sends the defect list header, which may be followed by a DList in physical sector format. The drive adds the DList to the existing GList. All sectors in the PList and GList are reallocated.
1	0	1	1	X	*Reserved*
1	1	0	X	X	*Format option without GList or DList*. The drive erases any previous GList. The initiator sends a defect list header but no DList. All sectors in the PList are reallocated.
1	1	1	0	0	The drive does not support bytes-from-index format.
1	1	1	0	1	*Format option with DList only.* The drive erases any previous GList. The initiator sends the defect list header, which may be followed by a DList in physical sector format. The DList becomes the new GList. All sectors in the PList and GList are reallocated.
1	1	1	1	X	*Reserved*

3.4.4.3 Defect list header and defect list

The defect list, shown below, contains a 4-byte header, followed by one or more defect descriptors. Byte 1 of the defect list header determines whether the P and C defects are reallocated.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	FOV	DPRY	DCRT	STPF	0	0	0	0
2–3	Defect list length							
4–*n*	Defect descriptor							

Byte 1 If the *FOV* bit is 1, the DPRY, DCRT and STPF bits are interpreted. If the FOV bit is 0, the DPRY, DCRT and STPF bits must be zeros.

If the DPRY bit is 0, the defects described in the PList are reallocated during formatting. The drive sends a check condition status if it cannot find the PList. If DPRY is 1, the PList is maintained but the sectors are not reallocated.

If the *DCRT* bit is 1, the drive does not verify the data written during the format. Therefore, no CList for this format is created or reallocated. If the DCRT is 0, the drive verifies the data written during the format, creates a CList and reallocates sectors that were unrecoverable.

If the *STPF* bit is 1, the drive stops formatting if it encounters an error while accessing either the P or G defect list. If the *STPF* bit is 0, the drive continues formatting even though it has encountered an error while accessing either the P or G defect list.

Bytes 2–3 The *defect list length* is the length, in bytes, of the defect list that follows the header. For each sector to be reallocated, the defect list contains one defect descriptor that contains 8 bytes in either the bytes-from-index format or the physical sector format. A length of zero indicates that no DList follows; this is not an error.

Bytes 4–*n* The defect descriptors are described in Sections 3.4.4.4. on page 43. A length of zero indicates that no DList follows; *this is not an error.*

3.4.4.4 Defect descriptor—physical sector format

Defects are specified in the physical sector format when the defect list format field is 101_B. See Byte 1 of the Format Unit command in Section 3.4.4. on page 39.

Each defect descriptor for the physical sector format specifies a sector-size defect location that is composed of the cylinder number of the defect, the head number of the defect and the defect sector number. The defect descriptors must be in ascending order.

A defect sector number of $FFFFFFFF_H$ (which means reassign the entire track) is illegal.

The information in the following table is for each defect.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0–2	Cylinder number of defect							
3	Head number of defect							
4–7	Defect sector number							

3.4.5 Reassign Blocks command (07_H)

When the drive receives the Reassign Blocks command, it reassigns defective logical blocks to available spare sectors.

Note. ARRE and AWRE may perform automatic reassignments independently of this command.

After sending the Reassign Blocks command, the initiator transfers a defect list containing the logical block addresses to be reassigned. The drive reassigns the logical blocks. The data contained in the logical blocks may not be preserved.

The drive can repeatedly assign a logical block to multiple physical addresses until there are no more spare locations available on the disc.

If the drive does not have enough spare sectors to reassign all of the defective logical blocks, the command terminates with a check condition status, and the sense key is set to media error. The logical block address of the first logical block not reassigned is returned in the information bytes of the sense data.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	1	1	1
1	LUN			0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0

3.4.5.1 Reassign Blocks defect list

The Reassign Blocks defect list contains a 4-byte header followed by one or more defect descriptors. The length of each defect descriptor is 4 bytes.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2–3	Defect list length							
4–*n*	Defect descriptors							

Byte 2–3 The *defect list length* specifies the total length, in bytes, of the defect descriptors that follow. The defect list length is equal to four times the number of defects.

Bytes 4–*n* The *defect descriptor* contains the 4-byte logical block address of the defect. The defect descriptors must be in ascending order.

3.4.6 Read (6) command (08_H)

When the drive receives the Read command, it transfers data to the initiator.

The Read-Write Error Recovery page (01_H) determines how the drive handles errors during a Read command. The Read-Write Error Recovery page is discussed in Appendix C.1 on page 98.

If there is a reservation access conflict, this command terminates with a reservation conflict status and no data is read. For more information about the reservation conflict status, see Section 3.2. on page 35.

In systems that support disconnection, the drive disconnects when a valid Read command is received, unless the data is available in the cache buffer. The buffer-full ratio byte of the Disconnect/Reconnect page determines when the drive reconnects. (The Disconnect/Reconnect page is discussed in Section C.2. on page 100). The drive may disconnect, if allowed, whenever there is less than one block in the buffer.

Because the drive uses read look-ahead functions, it may read more data into the buffer than specified by the transfer length in the CDB.

Note. The Read (6) command cannot access all logical blocks on the drive. The Read (10) command must be used to access all logical blocks.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	0	0	0
1	LUN			Logical block address (MSB)				
2	Logical block address							
3	Logical block address (LSB)							
4	Transfer length							
5	0	0	0	0	0	0	0	0

Bytes 1–3 The *logical block address* specifies the logical block where the read begins.

Byte 4 The *transfer length* specifies the number of contiguous logical blocks of data to be transferred. A transfer length of 0 indicates that 256 logical blocks will be transferred. Any other value indicates the number of logical blocks transferred.

3.4.7 Write (6) command ($0A_H$)

When the drive receives the Write command, it writes the initiator's data to the disc.

The Read-Write Error Recovery page (01_H) determines how the drive handles bad sectors during a Write command. The Read-Write Error Recovery page is discussed in Appendix C.1 on page 98. If the system supports disconnection, the drive can disconnect and reconnect while executing this command. The drive disconnects when either an internal error-recovery procedure is required or the drive's internal data buffer is full. The buffer-empty ratio in the Disconnect/Reconnect page determines when the drive reconnects. Section C.2 on page 100 documents the Disconnect/Reconnect page.

If there is a reservation access conflict, this command terminates with a reservation conflict status and no data is written. For more information about the reservation conflict status, see Section 3.2. on page 35.

Note. The Write (6) command cannot access all logical blocks on the drive. The Write (10) command must be used to access all logical blocks.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	0	1	0
1	LUN			Logical block address (MSB)				
2	Logical block address							
3	Logical block address (LSB)							
4	Transfer Length							
5	0	0	0	0	0	0	0	0

Bytes 1–3 The *logical block address* specifies the logical block where the write operation begins.

Byte 4 The *transfer length* specifies the number of contiguous logical blocks of data to be transferred. A transfer length of zero indicates that 256 logical blocks are to be transferred. Any other value indicates the number of logical blocks to be transferred.

3.4.8 Seek (6) command ($0B_H$)

When the drive receives the Seek command, it seeks to the track of the specified logical block address. This command is not necessary because all commands that access the disc contain implied seeks. In systems that support disconnection, the drive disconnects when it receives a valid Seek command.

Note. The Seek (6) command cannot access all logical blocks on the drive. The Seek (10) command must be used to access all logical blocks.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	0	1	1
1	LUN			Logical block address (MSB)				
2	Logical block address							
3	Logical block address (LSB)							
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0

Bytes 1–3 The *logical block address* specifies the logical block to which the head seeks.

3.4.9 Inquiry command (12_H)

When the drive receives the Inquiry command, it sends the inquiry data to the initiator. When the requested inquiry data cannot be returned, a check condition status is reported.

If an Inquiry command is received from an initiator with a pending unit-attention condition (before the drive reports a check condition status), the drive performs the Inquiry command and the Unit Attention condition is not cleared.

The initiator should allocate 36_H bytes for inquiry data. The inquiry data returned to the initiator is summarized in Appendix D on page 117.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	0	1	0
1	LUN			Reserved				EVPD
2	Page code							
	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Allocation length, in bytes							
5	0	0	0	0	0	0	0	0

Byte 1 If the *enable vital product data (EVPD*) bit is zero, the drive returns the standard inquiry data. If the EVPD bit is one, the drive returns the optional vital product data specified in byte 2.

Byte 2 The *page code* field specifies which page of the vital product information the drive returns. If EVPD is zero, this field must be zero.

Byte 4 The *allocation length* specifies the number of bytes the initiator has allocated for returned inquiry data. The drive returns the number of bytes specified by the allocation length up to a maximum of 148 bytes. If the allocation length is zero, no data is returned. *This is not an error.* The allocation length should be at least 36_H to allow the initiator to receive all of the standard inquiry data.

3.4.10 Mode Select (6) command (15_H)

The Mode Select command allows the initiator to change parameters stored in the mode pages. The mode pages are described in Appendix C.on page 97. The drive stores four copies of each mode page:

- **Current values copy.** This copy contains the parameter values the drive uses to control its operation. After a power-on reset, hard reset or bus device reset, the current values are equal to the saved values if the saved values can be retrieved, or the default values if the saved values cannot be retrieved.
- **Changeable values copy.** This copy does not actually contain any parameters. Instead, it contains a map of each mode page, indicating which parameters are changeable by the initiator. If a bit contains a 1, the corresponding value in the mode page is changeable. If a bit contains a 0, the corresponding value in the mode page is not changeable. The changeability values for each bit of each mode page and the default values are listed in Appendix C.

- **Default values copy.** This copy contains the parameter values the drive used as its current values when it was manufactured. The drive defaults to these values after a reset condition, unless valid saved values are available. The default values are listed in Appendix C on page 97.
- **Saved values copy.** The saved values are the values the drive stores. If the parameter is changeable, these values can be set using a Mode Select command. If the parameter is not changeable, the default values are always used.

The drive has one set of mode parameters for all of the initiators on the SCSI bus. If the initiator that issued the Mode Select command changes a parameter that applies to other initiators, the drive generates a sense key of Unit Attention with an additional sense key of mode parameters changed (2AH/01) for all the other initiators. The sense keys and additional sense codes are discussed in Appendix B on page 91.

Before sending the Mode Select command, the initiator should send a Mode Sense command requesting that the drive return the changeable values for all pages. The initiator uses this information to determine which pages are supported, the proper length for those pages and which parameters in those pages can be changed for that logical unit. Also, before sending each Mode Select command, the initiator should send a Mode Sense command to request the current values.

When the drive receives the Mode Select command, it updates the savable parameters with the current values included in the Mode Select command. After the drive saves the parameters, it reports a good status. The drive verifies all Mode Select data.

If the drive detects invalid parameter data during the Mode Select command, it sends a sense key of *illegal request* with an additional sense code of *invalid field in parameter list*, and no parameters are changed.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	0	1
1	LUN			PF = 1	0	0	0	SP
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Parameter list length							
5	0	0	0	0	0	0	0	0

Byte 1 The *page format (PF)* bit is always one. This means that the data sent by the initiator after the mode select header and block descriptors complies with the page format.

When the *save pages (SP)* bit is 1, the drive saves the savable pages in nonvolatile memory.

When the *save pages (SP)* bit is 0, the drive saves the current pages in RAM only, which means that the parameters are lost when the drive is powered down.

Byte 4 The *parameter list length* specifies the length, in bytes, of the header and mode page transferred to the drive. A parameter list length of 0 means that no data is transferred. To calculate the parameter list length for any given mode page, add the parameter list header (4 bytes), the block descriptor (if any, 8 bytes), the 2-byte mode page header and the length of each mode page. For the length of the mode pages refer to Appendix C on page 97.

3.4.10.1 Mode Select parameter list

The Mode Select parameter list contains a 4-byte header, followed by a 1-block descriptor (if any), followed by the Mode Select parameter pages.

Each block descriptor specifies the media characteristics for all or part of a logical unit. The rest of the Mode Select parameters are grouped by function and organized into mode pages. The mode pages are described in Appendix C on page 97.

Bytes	Bits							
	7	6	5	4	3	2	1	0
Parameter list header								
0 (default)	Reserved (00_H)							
1 (default)	Medium type (00_H)							
2 (default)	Reserved (00_H)							
3 (default)	Block descriptor length (00_H or 08_H)							
(Optional) Block descriptor data								
4 (default)	Density code (00_H)							
5–7	Number of blocks							
8 (default)	Reserved (00_H)							
9–11	Block length							
Parameter information								
12–*n*	Mode pages							

Byte 1 The *medium type* field is always 00_H, which means that the drive is a direct-access device.

Byte 3 If the *block descriptor length* is 8 bytes, a block descriptor is sent to the drive. If the *block descriptor length* is 0 bytes, no block descriptor is sent to the drive.

Byte 4 The *density code* is always 00_H and cannot be changed.

Bytes 5–7 The *number of blocks* is equal to the guaranteed sectors, which is listed in the formatted capacity section of the appropriate product manual.

Bytes 9–11 The *block length* is always 0200_H and cannot be changed.

Note. Bytes 4–11 will be provided if the initiator requests the Block Descriptor.

3.4.11 Reserve (6) command (16_H)

When the initiator issues a Reserve command, it requests that the drive be reserved for exclusive use by the initiator until the reservation is:

- Superseded by another Reserve command from the initiator that made the reservation. An initiator that has already reserved the drive can modify that reservation by issuing another Reserve command. When the drive receives the superseding Reserve command, the previous reservation is canceled.
- Released by a Release command from the same initiator. See the Release command in Section 3.4.12 on page 52.
- Released by a bus device reset message from any initiator.
- Released by a hard reset.

After the drive honors the reservation from one initiator, it accepts Inquiry, Request Sense and Reserve and Release commands from other initiators; the drive rejects all other commands with a reservation conflict status.

Note. For the ST52160WC, the Release (6) command cannot release SCSI ID's 8–15. Use the Release (10) command.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	1	0
1	LUN			3rd pty	3rd party device ID			Extent
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0

Byte 1 If the *3rd pty* bit is 0, the initiator reserves the drive for itself. If the 3rd pty bit is 1, the initiator reserves the drive for another initiator. The SCSI ID of the third-party initiator is specified in the *3rd party device ID* field.

The *extent* bit must always be 0. The drive does not support extent reservations. If the extent bit is 1, the drive generates a check condition status.

3.4.12 Release (6) command (17_H)

When an initiator that had reserved the drive using the Reserve command issues the Release command, it cancels the reservation. If the drive is not currently reserved or is reserved by another initiator and it receives a Release command, the drive returns a good status and maintains the reservation.

Note. For the ST52160WC, the Release (6) command cannot release SCSI ID's 8–15. Use the Release (10) command.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	1	1
1	LUN			3rd pty	3rd party device ID			Extent
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0

Byte 1 If the *3rd pty* bit is 0, the initiator releases its own reservation. If the 3rd pty bit is 1, the initiator releases the drive for another initiator. An initiator can only release a third-party reservation

that it made. The SCSI ID of the third-party initiator is specified in the *3rd party device ID* field.

The *extent* bit must always be 0. The drive does not support extent reservations. If the extent bit is 1, the drive generates a check condition status.

3.4.13 Mode Sense (6) command ($1A_H$)

When the initiator sends this command to the drive, it returns mode-page parameters to the initiator. This command is used in conjunction with the Mode Select command.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	1	0
1	LUN			0	DBD	0	0	0
2	PC		Page code					
3	0	0	0	0	0	0	0	0
4	Allocation length							
5	0	0	0	0	0	0	0	0

Byte 1 A disable block descriptor (DBD) bit of zero indicates that the target may return zero or more block descriptors in the returned Mode Sense data. This is at the target's discretion. A DBD bit of one specifies that the target will not return any block descriptors in the returned Mode Sense data.

Byte 2 *The page control (PC)* field determines the content of Mode Parameter bytes. Regardless of the value of the PC, the block descriptor always contains the current values.

PC bit 7	PC bit 6	Effect
0	0	Return current values.
0	1	Return changeable values.
1	0	Return default values.
1	1	Return saved values.

The *page code* is the designator that is unique to each page. The page codes are listed in Section 3.4.13.1 on page 54.

Byte 4 The *allocation length* specifies the number of bytes that the initiator has allocated for returned Mode Sense data. An allocation length of 0 means that no Mode Sense data is to be

transferred. This condition is not considered an error. Any other value represents the number of bytes to be transferred. For a description of the allocation length, see Section 3.4.13.1.

3.4.13.1 Page code and allocation length

The Mode Sense command descriptor block contains a page code (byte 2, bits 5–0) and an allocation length (byte 4). These parameters are described in the following table for SCSI-3 devices. You can transfer mode pages to the initiator either of two ways:

- Transfer all mode pages at once by using page code $3F_H$, or
- Transfer one mode page at a time by using the page codes and any number greater than or equal to the allocation length of the mode page.

Page code	Allocation length	Mode Sense data returned
01_H	18_H	4 bytes of Mode Sense header 8 bytes of block descriptor 2 bytes of mode-page header 10 bytes of Read/Write Error Recovery parameters
02_H	$1C_H$	4 bytes of Mode Sense header 8 bytes of block descriptor 2 bytes of mode-page header 14 bytes of Disconnect/Reconnect parameters
03_H	24_H	4 bytes of Mode Sense header 8 bytes of block descriptor 2 bytes of mode-page header 22 bytes of Format Device parameters
04_H	24_H	4 bytes of Mode Sense header 8 bytes of block descriptor 2 bytes of mode-page header 22 bytes of Rigid Disc Geometry parameters
07_H	18_H	4 bytes of Mode Sense header 8 bytes of block descriptor 2 bytes of mode-page header 10 bytes of Verify Error Recovery Page parameters
08_H	20H	4 bytes of Mode Sense header 8 bytes of block descriptor 2 bytes of mode-page header 18 bytes of Caching parameters

Page code	Allocation length	Mode Sense data returned
$0A_H$	18_H	4 bytes of Mode Sense header 8 bytes of block descriptor 2 bytes of mode-page header 10 bytes of Control Mode page parameters
00_H	10_H	4 bytes of Mode Sense header 8 bytes of block descriptor 2 bytes of mode-page header 2 bytes of Unit Attention Page parameters

3.4.13.2 Mode Sense data

The Mode Sense parameter list contains a 4-byte header followed by an 8-byte block descriptor (if any), followed by the mode pages. The header and block descriptor are shown below. The mode pages are described in Appendix C on page 97.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	Mode Sense data length							
1 (default)	Medium type (00_H)							
2	WP=0	Reserved						
3 (default)	Block descriptor length (08_H)							
(Optional) Block descriptor								
4 (default)	Density code (00_H)							
5–7	Number of blocks							
8 (default)	Reserved (00_H)							
9–11	Block length							
Mode pages								
12–*n*	Mode pages							

Byte 0 The *Mode Sense data length* specifies the number of bytes minus 1 of the Mode Sense data to be transferred to the initiator.

Byte 1 The *medium type* is always 0.

Byte 2 The *WP (write protect)* bit is always 0, which means the media is write-enabled.

Byte 3 The *block descriptor length* is the number of bytes in the block descriptor. This value does not include the page headers and mode pages that follow the block descriptor, if any.

Byte 4 The *density code* is not supported.

Bytes 5–7 The *number of blocks* field contains the total number of blocks available to the user.

Byte 8 Reserved

Bytes 9–11 The *block length* specifies the number of bytes contained in each logical block described by the block descriptor.

3.4.14 Start/Stop Unit command ($1B_H$)

When the drive receives the Start/Stop Unit command, the drive either spins up or spins down, depending on the setting of the start bit in byte 4.

If the host adapter supports disconnection, the drive disconnects when it receives the Start/Stop Unit command and reconnects when it is up to speed and ready.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	1	1
1	LUN = 0			0	0	0	0	Immed
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	Start
5	0	0	0	0	0	0	0	0

Byte 1 If the *immediate (Immed)* bit is 0, the drive returns the status after the command is completed. If the Immed bit is 1, the drive returns the status when it receives the command.

Byte 4 If the *start* bit is 1, the drive spins up. If the *start* bit is 0, the drive spins down.

3.4.15 Receive Diagnostic Results command ($1C_H$)

When the drive receives the Receive Diagnostics command after power-up or after a Send Diagnostic command of PF=0, it sends eight diagnostic data bytes to the initiator. The drive supports the optional Page format wherein the initiator sends additional pages after a Send Diagnostic command. These additional pages have a page code that specifies to the drive the format of the data to be returned after it receives a Receive Diagnostic Results command.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	0	0
1	LUN = 0			0	0	0	0	0
2	0	0	0	0	0	0	0	0
3–4	Allocation length							
5	0	0	0	0	0	0	0	0

Bytes 3–4 The *allocation length* specifies the number of bytes the initiator has allocated for returned diagnostic result data. An allocation length of 0 means that no diagnostic data is transferred; *this is not an error.* The drive sends the lesser of the allocation length or the bytes available, whichever number is less.

3.4.15.1 Diagnostic data format

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0–1 (default)	Additional length (0006_H)							
2–5	FRU code							
6	Diagnostic error code							
7	Vendor-unique error code							

Byte 0–1 The *additional length* value indicates the number of additional bytes included in the diagnostic data list. A value of 0000_H means that there are no additional bytes. A value of 0006_H means that no product-unique bytes are available.

Bytes 2–5 If the *field replaceable unit (FRU)* code is 00_H, there is no FRU information. If the FRU code is 01_H, replace the drive. Other values are drive-unique.

Byte 6 The *diagnostic error code* is not supported.

Byte 7 The *vendor-unique error codes* are listed in Section 3.4.15.2.

3.4.15.2 Diagnostic error codes

The following diagnostic error codes are reported in byte 7 of the diagnostic data format in Section 3.4.15.1.

Error code	Description
01_H	Sequencer test error
02_H	Microprocessor RAM diagnostic error
09_H	Fatal hardware error during drive diagnostics
44_H	EEPROM test error
80_H	Buffer controller diagnostic error
81_H	Buffer RAM diagnostic error

3.4.16 Supported Diagnostic Pages

The following table lists all of the diagnostic pages that supports the drive. If the Send Diagnostics command requests the Supported Diagnostics Page list (PF=1), the drive returns data in the format shown in the table below, after it receives the Receive Diagnostics Results command.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	Page Code (00_H)							
1	Reserved							
2–3	Page Length (*n*–3) (1)							
4 : n	Supported Page List (2)							

Notes:

1. The page length field specifies the length in bytes of the supported page list.

2. The supported page lists contains a list of all diagnostic page codes implemented by the drive in ascending order begin-

ning with page code 00_H. The drive supports only pages 00_H and 40_H.

3.4.17 Translate Address Page

The translate address page allows the initiator to translate a logical block address into a physical sector address or a physical sector address into a logical block address. The address to be translated is passed to the target during the data-out phase. This phase is associated with the Send Diagnostics command and the results are returned to the initiator during the data-in phase following the Receive Diagnostic command. The translated address is returned in the Translate Address Page as shown in the following tables.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (40_H) (1)							
1	Reserved							
2–3	Page Length (000A) (2)							
4	Reserved				Supplied Format (3)			
5	RAREA (4)	ALTSEC (5)	ALTTK (6)	Rsrvd	Translated Format (7)			
6 : 13	Translated Address (8) (if available)							

Notes:

1. The translate address page contains a 4-byte page header that specifies the page code and length followed by 2 bytes, which describe the supplied format followed by the translated address.

2. The page length field contains the number of parameters that follow.

3. The Supplied Format field contains the value from the Send Diagnostic command supplied format field.

4. A reserved area (RAREA) bit of 1 indicates that all or part of the translated address falls within a reserved area of the medium (such as speed tolerance gap, alternate sector and vendor-reserved area). If the entire translated address falls within a reserved area, the target may not return a trans-

lated address. A RAREA bit of zero indicates that no part of the translated address falls within a reserved area of the medium.

5. An alternate sector (ALTSEC) bit of 1 indicates that the translated address is physically located in an alternate sector of the medium. If the drive cannot determine whether all or part of the translated address is located in an alternate sector, it will set this bit to zero. An ALTSEC bit of zero indicates that no part of the translated address is located in an alternate sector of the medium or that the drive is unable to determine this information.

6. An alternate track (ALTTRK) bit of 1 indicates that part or all of the translated address is located on an alternate track. An ALTTRK bit of zero indicates that no part of the translated address is located on an alternate track of the medium.

7. The Translated Format field contains the value from the Send Diagnostic command translate format field).The values are 000 (Logical block format) or 101 (Physical sector address format).

8. The Translated Address field contains the address supplied by the initiator in the Send Diagnostic command. This field will be in the format specified in the translate format field. The supported formats are shown in the following tables.

Address Field Logical Block Address Format

Bytes	Bits							
	7	6	5	4	3	2	1	0
0–3	Logical Block Address							
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0

Address Field Physical Sector Format

Bytes	Bits							
	7	6	5	4	3	2	1	0
0–2	Cylinder Number							
3	Head Number							

Address Field Physical Sector Format								
Bytes	**Bits**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
4–7	Sector Number							

3.4.18 Send Diagnostic command ($1D_H$)

When the drive receives this command, it performs diagnostic tests on itself. In systems that support disconnection, the drive disconnects while executing this command.

Bytes	**Bits**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	0	1
1	LUN = 0			PF	0	Self Test	Dev OfL	Unit OfL
2	0	0	0	0	0	0	0	0
3–4	Parameter list length							
5	0	0	0	0	0	0	0	0

Byte 1 If the PF (Page Format) bit is set to 0 and the *SelfTest* bit is set to 1, the drive performs the buffer RAM diagnostics, which is the default self-test. If the default self-test is requested, the parameter list length is 0 and no data is transferred. If the self-test passes successfully, the command terminates with a good status. If the self-test fails, the command terminates with a check condition status and the sense key is hardware error.

If the PF bit is set to 1, SelfTest bit is 0, *device off line* (DevOfL) and *unit off line* (UnitOfL) are ignored and a diagnostic page is sent as the parameter list. The supported pages are the *Supported Pages* (00_H) page and the *Translate Address* (40_H) page. The parameter length is 4 (04_H) bytes for page 00_H and 14 ($0E_H$) bytes for page 40_H.

The DevOfL bit is not supported and must be 0 if *SelfTest* bit =1.

The UnitOfL bit is not supported and must be 0 if *SelfTest* bit =1.

Bytes 3–4 The *parameter list length* must be 0 if *SelfTest* bit =1.

3.5 Supported Diagnostics Page—Send Diagnostics

This page contains instructions for the drive to make available the list of all supported diagnostic pages to be returned by a subsequent Receive Diagnostics Results command. The definition of this page includes only the first 4 bytes. If the page length is *not* zero, the drive shall terminate the Send Diagnostics command with a Check Condition status. The Sense Key shall be set to Illegal Request with an additional sense code of Invalid Field Parameter List.

Supported Diagnostic Pages Page								
Bytes	**Bits**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (00_H)							
1	Reserved							
2–3	Page Length (Must Be Zero)							

3.6 Translate Address Page—Send Diagnostic

The translate address page allows the initiator to translate a logical block address into a physical sector address or a physical sector address into a logical block address. The address to be translated is passed to the drive with the Send Diagnostics command, and the results are returned to the initiator during the data-in phase following the Receive Diagnostic command. The format of the translate address page—Send Diagnostic, is shown in the following table. The translated address is returned in the translate address page returned after the Receive Diagnostic Results Command.

Bytes	**Bits**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (40_H) (1)							
1	Reserved							
2–3	Page Length ($000A_H$)							
4	Reserved				Supplied Format (1)			
5	Reserved				Translated Format (7)			
6 : 13	Address To Translate (3)							

Notes:

1. The Supplied Format field specifies the format of the address to translate field. The valid values for this field are 000 for logical block address format or 101 for physical sector address format. If the drive does not support the requested format it terminates the Send Diagnostic command with a Check Condition status. The sense key is set to Illegal Request and an additional sense code is set to Invalid Field in the Parameter List.

2. The Translate Format field specifies the format to which the initiator wants the address to be translated. The valid values for this field are 000 for logical block address format or 101 for physical sector address format. The Translate Format field must be different than the Supplied Format field. If the drive does not support the requested format it terminates the command with a Check Condition status. The sense key is set to Illegal Request and an additional sense code is set to Invalid Field in Parameter List.

3. The Address to Translate field contains a single address that the initiator is requesting the drive to translate. The format of this field is defined by the Supplied Format field.

For systems that support disconnection, the drive disconnects while executing this command.

3.6.1 Read Capacity command (25_H)

The initiator uses the Read Capacity command to determine the capacity of the drive. When the drive receives the Read Capacity command, it sends the initiator read capacity data, which is described in Section 3.6.1.1. on page 64.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	0	0	1	0	1
1	LUN			0	0	0	0	0
2–5	Logical block address							
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	PMI
9	0	0	0	0	0	0	0	0

Bytes 2–5 The logical block address specified in the CDB cannot be greater than the logical block address reported by the drive in the read capacity data else check condition.

Byte 8 If the *partial medium indicator (PMI)* bit is zero, the logical block address in the CDB is also zero. The read capacity data returned by the drive contains the logical block address and block length of the last logical block of the drive.

If the PMI bit is 1, the drive returns the read capacity data, which contains the logical block address and block length of the last logical block address, after which a substantial delay (approximately 1 msec) in data transfer occurs. This logical block address must be greater than or equal to the logical block address specified in the CDB. This reported logical block address is a track (head) boundary.

3.6.1.1 Read Capacity data

The Read Capacity data is shown below.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0–3	Logical block address							
4–7	Block length (00000200_H)							

Bytes 0–3 The logical block address is determined by the PMI bit in the CDB of the Read Capacity command. The PMI bit is described in Section 3.6.1. on page 63.

Bytes 4–7 The block length is always 512.

3.6.2 Read (10) command (28_H)

When the drive receives the Read (10) command, it transfers data to the initiator. This command is the same as the Read (6) command discussed in Section 3.4.6 on page 45 except that in the CDB for the Read (10) command, a 4-byte logical block address and a 2-byte transfer length can be specified.

If there is a reservation access conflict, this command terminates with a reservation conflict status and no data is read. For more information about the reservation conflict status, see Section 3.2 on page 35.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	0	0	1	0	1	0	0	0
1	LUN			DPO	FUA	0	0	0
2–5	Logical block address							
6	0	0	0	0	0	0	0	0
7–8	Transfer length							
9	0	0	0	0	0	0	0	0

Byte 1 If the *disable page out (DPO)* bit is 1, the cached data that the drive receives during this command has the lowest priority for being retained in the cache. If the DPO is 0, the cached data has the highest priority for being retained in the cache.

If the *forced unit access (FUA)* bit is 1, the drive must access the disc to get the data requested by the initiator, even if the data is available in the cache. If the FUA bit is 0, the drive can get the data from the cache or the disc.

Bytes 2–5 The *logical block address* specifies the logical block where the read operation begins.

Bytes 7–8 The *transfer length* specifies the number of contiguous logical blocks of data to be transferred. A transfer length of 0 means that no logical blocks are to be transferred. This condition is not considered an error.

3.6.3 Write (10) command ($2A_H$)

When the drive receives the Write (10) command, the drive writes the data from the initiator to the disc. This command is the same as the Write (6) command, except that the CDB for this command contains a 4-byte logical block address and a 2-byte transfer length. For more information about the Write (6) command, see Section 3.4.7 on page 46.

If there is a reservation access conflict, this command terminates with a reservation conflict status and no data is written. For more information about the reservation conflict status, see Section 3.2. on page 35.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	0	0	1	0	1	0	1	0
1	LUN			DPO	FUA	0	0	0
2–5	Logical block address							
6	0	0	0	0	0	0	0	0
7–8	Transfer length							
9	0	0	0	0	0	0	0	0

Byte 1 If the *disable page out (DPO)* bit is 1, the cached data that the drive receives during this command has the lowest priority for being retained in the cache. If the DPO is 0, the cached data has the highest priority for being retained in the cache.

If the *forced unit access (FUA)* bit is 1, the drive must access the disc to write the data sent by the initiator, even if the data can be stored in the cache. If the FUA bit is 0, the drive can write the data to the cache or the disc.

Bytes 2–5 The *logical block address* specifies the logical block where the write operation begins.

Bytes 7–8 The *transfer length* specifies the number of contiguous logical blocks of data to be transferred. A transfer length of 0 means that no logical blocks are to be transferred; this is not an error.

3.6.4 Seek (10) command ($2B_H$)

The Seek (10) command requests that the drive seek to the specified logical block address. This command is the same as the Seek (6) command, except that the CDB includes a 4-byte logical block address. The Seek (6) command is described in Section 3.4.8. on page 47.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	0	0	1	0	1	0	1	1
1	LUN			0	0	0	0	0
2–5	Logical block address							
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0

3.6.5 Write and Verify command ($2E_H$)

When the drive receives the Write and Verify command, it writes the data sent by the initiator to the media and then verifies that the data is correctly written.

If the host adapter supports disconnection, the drive disconnects while it is executing this command.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	0	0	1	0	1	1	1	0
1	LUN			0	0	0	BytChk	0
2–5	Logical block address							
6	0	0	0	0	0	0	0	0
7–8	Transfer length							
9	0	0	0	0	0	0	0	0

Byte 1 If the *byte check (BytChk)* bit is 0, the drive verifies the media after a write by checking the ECC syndromes. If the BytChk bit is one, the drive verifies the media after a write by performing a byte-by-byte comparison of the data stored.

Bytes 2–5 The *logical block address* field specifies the logical block where the drive begins writing and verifying the data.

Bytes 7–8 The *transfer length* field specifies the number of contiguous logical blocks to be transferred. If the transfer length is 0, the initiator does not transfer any data and the drive does not write or verify any data. This condition is not considered an error.

3.6.6 Verify command ($2F_H$)

When the drive receives the Verify command, it verifies the data on the disc. If the host adapter supports disconnection, the drive disconnects while it is executing this command.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	0	1	1	1	1
1	LUN			0	0	0	Byt Chk	0
2–5	Logical block address							
6	0	0	0	0	0	0	0	0
7–8	Verification Length							
9	0	0	0	0	0	0	0	0

Byte 1 If the *byte check (BytChk)* bit is 0, the drive verifies the media by checking the ECC syndromes. If the BytChk bit is 1, the drive verifies the media by performing a byte-by-byte comparison of the data sent from the initiator.

Bytes 2–5 The *logical block address* field specifies the logical block where the drive begins verifying the data.

Bytes 7–8 The *verification length* field specifies the number of contiguous logical blocks to be verified. If the verification length is 0, the drive does not verify any logical blocks, although an implied seek is still performed. This condition is not considered an error.

3.6.7 Read Defect Data command (37_H)

When the drive receives this command, it reads the defect data and transfers the defect data to the initiator.

This command can be used in conjunction with the Format Unit command. Read Defect Data reads the defect lists off the buffer memory and resends the lists as defect data but does not change the lists.

The Read Defect Data command can be used to access two types of defect lists: the *primary defect list (PList)* and the *grown defect list (GList)*. These lists are described in Section 3.4.4.1. on page 40.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	0	1	1	1
1	LUN			0	0	0	0	0
2	0	0	0	PList	GList	Defect list format		
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7–8	Allocation length							
9	0	0	0	0	0	0	0	0

Byte 2 If the *PList* bit is 1, the drive sends the primary defect list. If the PList bit is 0, the drive does not send the primary defect list.

If the *GList* bit is 1, the drive sends the grown defect list. If the GList bit is 0, the drive does not send the grown defect list.

If both the PList and GList bits are zero, the drive returns the defect list header only.

If the defect list format field contains 101_B, the drive returns the defect data in the physical sector format. If the defect list format field contains 000_B or 100_B, the drive returns the defect data in the default format, which is the physical sector format, and generates a check condition status.

Bytes 7–8 The allocation length specifies the number of bytes the initiator has allocated for the returned defect data; *this is not an error.* An allocation length of 0 indicates that no defect data is transferred. The data-in phase ends when the allocation length bytes have been transferred or when all available defect data has been transferred to the initiator, whichever is less.

3.6.7.1 Defect list header

The defect data always begins with a 4-byte header, followed by an 8-byte descriptor for each defect. The defect list header format is described below.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	0	0	0	PList	GList	Defect list format		
2–3	Defect List Length							

Byte 1 If the *PList* bit is 1, the defect data contains the primary defect list. If the PList bit is 0, the defect data does not contain the primary defect list.

If the *GList* bit is 1, the defect data contains the grown defect list. If the GList bit is 0, the defect data does not contain the grown defect list.

The *defect list format* field is described in Section 3.6.7. on page 68.

Bytes 2–3 The defect list length always specifies the length of the defect data in bytes, even if the allocation length (in the CDB) is not large enough to accommodate all the defect descriptors. If the PList and GList bits are 0, no defect descriptor bytes are sent to the initiator and the defect list length is 0.

3.6.8 Write Data Buffer command ($3B_H$)

The Write Data Buffer command supports several different features. It can be used with the Read Data Buffer command to diagnose problems in the drive's data buffer memory and to test the integrity of the SCSI bus.

You can also use the Write Data Buffer command to download microcode to the buffer and to save it in flash memory.

Note. This command treats the buffer as a single segment, regardless of the number of segments specified in Caching page 08_H. (Caching page 08_H is described in Section C.6.3. on page 110.)

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	1	0	1	1
1	LUN			0	0	Mode		
2	Buffer ID (00_H)							
3–5	Buffer offset							
6–8	Parameter list length							
9	0	0	0	0	0	0	0	0

Byte 1 If the *mode* bits contain 000_B, the initiator transfers data to the drive buffer with a 4-byte header that contains all zeros. This mode is called *write combined header and data*.

If the *mode* bits contain 010_B, the initiator transfers data to the drive buffer without the header. This mode is called *write data*.

If the *mode* bits contain 101_B, the initiator downloads microcode to the drive buffer, and the drive saves the microcode in flash memory. The drive uses the new microcode for all future operations. This mode is called *download microcode and save*.

After the microcode has been successfully downloaded, the drive generates a unit attention condition of *microcode has been downloaded* for all initiators except the one that issued the current Write Data Buffer command.

All other settings for the mode bits are reserved.

Byte 2 This field is ignored if the mode bits are 101_B.

Byte 3–5 The *buffer offset* is added to the starting address of the buffer to determine the destination of the first data byte. The bytes that follow are placed in sequential addresses. If the sum of the buffer offset and the transfer length exceeds the buffer size reported by the Read Data Buffer command (see Section 3.6.9), the drive generates a check condition status and the initiator does not transfer any data. This field is ignored if the mode bits are 101_B.

Bytes 6–8 The *parameter list length* field specifies the maximum number of bytes the initiator transfers. If the initiator transfers the 4-byte header, the transfer length includes the header. If the transfer length is zero, no data is transferred to the drive buffer; this is not considered an error. The field is ignored if the mode bits are 101_B.

3.6.9 Read Data Buffer command ($3C_H$)

The Read Data Buffer command supports several different features. The Read Data Buffer command can be used along with the Write Data Buffer command to diagnose problems in the drive's data buffer memory and to test the integrity of the SCSI bus.

Note. This command treats the buffer as a single segment, regardless of the number of segments specified in mode page (08_H). (Mode page (08_H), the Caching page, is described in Section C.6. on page 108).

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	1	1	0	0
1	LUN			0	0	Mode		
2	Buffer ID (00_H)							
3–5	Buffer offset							
6–8	Allocation length							
9	0	0	0	0	0	0	0	0

Byte 1 If the mode bits contain 000_B, the initiator reads data from the drive buffer. The data is preceded by a 4-byte header. This mode is called *read combined header and data.*

If the mode bits contain 010_B, the initiator reads data from the drive buffer without a header. This mode is called *read data.*

If the *mode* bits contain 011_B, a maximum of 4 bytes of READ BUFFER descriptor information is returned. The drive returns the descriptor information for the buffer specified by the buffer ID.

If there is no buffer associated with the specified buffer ID, the drive returns all zeros in the READ BUFFER descriptor. The buffer offset is reserved in this mode. The allocation length should be set to four or greater. The drive transfers the lesser of the allocation length or 4 bytes of READ BUFFER descriptor.

READ BUFFER Descriptor								
Bytes	**Bits**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Offset Boundary							
1–3	(MSB)	Buffer Capacity						(LSB)

The offset boundary field returns the boundary alignment within the selected buffer for subsequent WRITE BUFFER and READ BUFFER commands. The value contained in the offset boundary field shall be interpreted as a power of two.

Buffer Offset Boundary		
Offset Boundary	**20 Offset Boundary**	**Buffer Offsets**
5	$2^5 = 32$	32-byte boundaries
FF_H	Not Applicable	0 is the only supported buffer offset

The buffer capacity field returns the size of the selected buffer in bytes.

All other settings for the *mode* bits are reserved.

Byte 2 The *buffer ID* is not supported and must always be zero.

Byte 3–5 The *buffer offset* is added to the starting address of the buffer to determine the source of the first data byte. The bytes that follow are read from sequential addresses. If the sum of the buffer offset and the transfer length exceeds the available length reported in the Read Buffer header (see Section 3.6.9.1), the drive transfers all the data contained in the buffer.

Bytes 6–8 The *allocation length* field specifies the maximum number of bytes read by the initiator. If the 4-byte header is transferred, the transfer length includes the header. If the transfer length is zero, no data is read; *this is not an error.*

3.6.9.1 Read Buffer Header

The following table shows the structure of the 4-byte Read Buffer Header.

Bytes	**Bits**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0							
1–3	Buffer capacity							

Bytes 1–3 The *buffer capacity* field specifies the size of the drive buffer. Byte 1 is MSB; byte 3 is LSB.

3.6.10 Read Long command ($3E_H$)

When the drive receives the Read Long command, it transfers data to the initiator.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	1	1	1	0
1	LUN			0	0	0	0	0
2–5	Logical block address							
6	0	0	0	0	0	0	0	0
7–8	Byte transfer length							
9	0	0	0	0	0	0	0	0

Bytes 2–5 The *logical block address* specifies the LBA where the drive begins reading data.

Bytes 7–8 The *byte transfer length* specifies the number of bytes transferred to the initiator. The drive transfers the logical block size plus twenty. If the byte transfer length is 0, the drive does not transfer any data to the initiator. This condition is not considered an error. Otherwise, transfer length must be 532 (214_H) Bytes.

3.6.11 Write Long command ($3F_H$)

When the drive receives the Write Long command, it writes one logical block of data and twenty bytes of error correction code (ECC) to the disc. During this command, the drive does not perform any ECC verification.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	1	1	1	1
1	LUN			0	0	0	0	0
2–5	Logical block address							
6	0	0	0	0	0	0	0	0
7–8	Byte transfer length							
9	0	0	0	0	0	0	0	0

Bytes 2–5 The *logical block address* specifies the LBA where the drive begins writing data.

Bytes 7–8 The *byte transfer length* specifies the number of bytes the initiator transfers to the drive.

If the transfer length does not equal the sum of the logical block size plus twenty, the command is terminated with a check condition status.

If the byte transfer length is zero, the initiator does not transfer any data to the drive; this condition is not considered an error. Otherwise, the transfer length must be 532 (214_H) bytes.

3.7 Group 2 commands

3.7.1 Log Select command ($4C_H$)

The Log Select command ($4C_H$) provides a means for an initiator to manage the statistical data maintained by the drive about drive operation. Initiators that implement the Log Select command shall also implement the Log Sense command.

Note. The initiator should issue the Log Sense command before issuing the Log Select command to determine supported pages and page length.

The data is structured in log pages and is managed through the log parameters within log pages. The Log Select command allows the initiator to select log pages and provides global management for the logs it selects. The initiator can select 0 or additional log pages.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	0	0	1	1	0	0
1	Reserved						PCR	SP
2	PC		Reserved					
3-6	Reserved							
7–8	Parameter list length							
9	0	0	0	0	0	0	0	0

Byte 1 If the *parameter code reset (PCR)* bit is set to 1 and the parameter list length is 0, all implemented parameter values will be set to their factory-default values. If the PCR bit is set to 1 and the parameter list length is greater than 0, the command is terminated and a CHECK CONDITION status is issued. The sense key will be set to ILLEGAL

REQUEST and the additional sense code will be set to INVALID FIELD IN CDB. If the PCR bit is set to 0, the log parameters will not be reset.

The *save parameters (SP)* bit determines whether the drive will save to nonvolatile memory all parameters indentified as savable in the *disable save (DS)* bit of the log page after a Log Select operation completes. If the bit is set to 1, the parameters are saved. If the bit is set to 0, the parameters are not saved.

If the drive does not implement saved parameters for any log parameter and the SP bit is set to 1, the command is terminated and a CHECK CONDITION status is issued. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN CDB. If the PCR bit is set to 0, the log parameters will not be reset.

It is not an error to set the SP bit to 1 and the DS bit to 1. In this case the parameter values are not saved.

Byte 2 The page control (PC) field defines the type of parameter values to be selected.

The page control values for the Log Select command are:

Type	**Parameter values**
00_B	Threshold value
01_B	Cumulative value
10_B	Default threshold value
11_B	Default cumulative value

Bytes 7–8 The *parameter list length* field specifies the length in bytes of the parameter list. If the parameter length is zero, no pages are transferred. *This is not an error condition.*

If the initiator sends page codes or parameter codes within the parameter list not reserved or not implemented, the drive terminates the Log Select command and returns a CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN PARAMETER LIST.

If a parameter list length field specifies the length in the truncation of any log parameter, the drive terminates the command and returns a CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST and the additional sense code will be set to INVALID FIELD IN CDB.

If multiple log pages are sent to the data buffer, they should be sent in ascending order by page code. If there are multiple parameters within a page, they should be sent in ascending order by parameter code. If the page codes are sent out of order, the device server should return CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST, and the additional sense code will be set to INVALID FIELD IN PARAMETER LIST.

3.7.1.1 Log page format

The log page format allows the initiator to specify attributes it wants to monitor and provides additional parametric instructions that the initiator can set for the specific attribute. Both the Log Select command and the Log Sense command use the Log page. However, the Log Sense command does not use all of the functions of the Log page. This section discusses the Log page format and applies to both commands. Differences in how the Log Sense command uses log pages are discussed in the Log Sense section.

Bytes	**Bits**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved		Page Code					
1	Reserved							
2–3	Page length (*n*–3)							
	Log Parameter Structure							
4 to *x* + *3*	Log Parameter (First) (Length x bytes*)*							
n – *y*	Log Parameter (last) (Length *y* bytes*)*							

Byte 0 The page code is the code assigned to an attribute the drive monitors. It specifies the log page that is being transferred. The page codes the drives support are listed and described below:

Page	Description
02_H	Error Counter Page (Write)
03_H	Error Counter Page (Read)
05_H	Error Counter Page (Verify)
06_H	Nonmedium Error page
37_H	Cache Statistics page

Parameter codes 00_H through 06_H specify six counters each for write, read and verify errors (18 counters). A description of the type (category of error) counters specified by codes 00_H through 06_H are described below.

Parameter Code 00_H—*Error Corrected Without Substantial Delay*. An error correction was applied to get perfect data (also known as ECC on-the fly). *Without Substantial Delay* means the correction did not postpone reading of later sectors (that is, a revolution was not lost). The counter is incremented once for each logical block that requires correction. Two different blocks corrected during the same command are counted as two events.

Parameter Code 01_H—*Error Corrected with Possible Delays*. An error code or algorithm (that is, ECC, checksum) is applied to get perfect data with substantial delay. *With Possible Delays* means the correction took longer than a sector time so that reading/writing of subsequent sectors was delayed (that is, a lost revolution). The counter is incremented once for each logical block that requires correction. A block with a double error that is correctable counts as one event and two different blocks corrected during the same command count as two events.

Parameter Code 02H—*Total (rewrites or rereads)*.This parameter code specifies the counter counting the number of errors that are corrected by applying retries. This counts errors recovered, not the number of retries. If five retries are required to recover one block of data, then one is added to the counter, not five. The counter is increased once for each logical block that is recovered using retries. If an error is not recoverable while applying retries and is recovered by ECC, it is not counted by this counter; it is counted by the counter specified by parameter code 01_H—Error Corrected with Possible Delay.

Parameter Code 03_H—*Total Errors Corrected.* This counter counts the total of all correctable errors encountered. It is the sum of the counters specified by parameter codes 01_h and 02_h. There is no double counting of data errors among these two counters and all correctable data errors are counted in one of these counters.

Parameter Code 04_H—*Total Times Correction Algorithm Processed*. This parameter code specifies the counter that counts the total number of retries, or times the retry algorithm is invoked. If after five attempts a counter 02_H type error is recovered, then five is added to this counter. If three retries are required to get a stable ECC syndrome before a counter 01_H type error is corrected, then three retries are also counted. The number of retries applied to unsuccessfully recover an error (counter 06_H type error) are also counted by this counter.

Parameter Code 05_H—Total Bytes Processed. This parameter code specifies the counter that counts the total number of bytes either successfully or unsuccessfully read, written or verified (depending on the log page) from the disc drive. If a transfer terminates early because of an unrecoverable error, only the logical blocks up to and including the one with the unrecoverable error are counted. Data bytes transferred to the initiator during a Mode Select, Mode Sense, Inquiry and Write Data Buffer, do not count; only user-data bytes are counted by this counter.

Parameter Code 06_H—Total Uncorrected Errors. This parameter code specifies the counter that contains the total number of blocks for which an unrecoverable data error has occurred.

Bytes 2–3 The page length field specifies the length of the attached log parameters in bytes. If the application client sends a page length that is inadequate and truncates any parameter, the device server terminates the command and issues a CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN PARAMETER LIST.

Bytes 4–*n* Log parameters are the special data structure for each page code used in the log page. Log parameters may be data counters that record a count of a particular event (or events), the circumstances under which certain operations were performed, or list parameters (strings) that contain a description of a particular event. The log parameter format is shown and described on the following page.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0–1	Parameter Code							
2	DU	DS	TSD	ETC	TMC		Reserved	LP
3	Parameter length (*n*–3)							
4	Parameter value							
n								

Bytes 1–0 The page code is the code assigned to an attribute the drive monitors.

Byte 2 The collective field in byte 2 is referred to as the parameter control byte. For the Log Select command, these bits perform a control function; for the Log Sense command, they report the drive settings. A description of each bit is provided below:

The *disable update (DU)* bit determines whether the drive updates cumulative log parameter values. When the DU bit is 0, the drive updates the log parameter values to reflect all events that should be noted by that parameter. When the DU bit is 1, the drive does not update the log parameter value except in response to a Log Select command that specifies a new value for the parameter.

The drive uses volatile memory to hold cumulative values. The values are lost during a power cycle unless the initiator commands the drive to save them in nonvolatile memory.

The DU bit is not defined for threshold values or list parameters.

The *disable save (DS)* bit indicates whether the drive saves the log parameter. When DS is 0, the drive saves the current cumulative or threshold parameter value when the SP bit in the Log Select or Log Sense command is 1. When DS is 1, the drive saves the current cumulative or threshold parameter value when the SP bit in the Log Select or Log Sense command is 1.

The *target save disable (TSD)* bit enables the drive to save the log page data automatically to ensure statistical significance. When TSD is 0, the drive saves at a frequency determined by Seagate. When TSD is 1, the drive does not automatically save.

When the *enable threshold comparison (ETC)* bit is 1, the threshold value is compared to the cumulative value each

time the cumulative value is updated. When the ETC bit is 0 no comparison is made. The ETC bit value is the same for both the threshold and cumulative values.

The *threshold met criteria (TMC)* bit defines the basis for comparison of the cumulative and threshold values. The TMC field is valid only when ETC is 1. The codes used in this field are listed below.

Code	Basis for Comparison
00_B	Notify of every update of cumulative value
01_B[9]	Cumulative value equal to threshold value
10_B[9]	Cumulative value not equal to threshold value
11_B[9]	Cumulative value greater than threshold value

If the ETC bit is 1[10] and the comparison result is true, a unit attention condition is generated for all initiators. When reporting the unit attention condition, the drive sets the sense key to unit attention condition and the additional sense code to threshold condition met.

The *list parameter (LP)* bit indicates the log parameter format. When the LP bit is 0, the parameter is a data counter. When the LP bit is 1, the parameter is a list parameter (an ASCII string). The drive does not support list parameters.

Data counters are associated with one or more events and are incremented whenever one of the events occur. The data counter may have a maximum value assigned to it. If that value is reached, the drive sets the DU bit to 1. Setting the DU bit to 1 causes all of the other counters in the log page to cease counting. If the data counter reaches its maximum value during the execution of a command, the drive completes the command. Drive counter updates are performed in the background. If the command completes correctly and if the report log exception condition (RLEC) bit in Control Mode Page $0A_H$ is set to 1, the drive issues a Unit Attention with the additional sense code set to Log Counter at Maximum. The counters do not restart automatically if the overflowed counter is reinitialized.

Byte 3 The *parameter length* field specifies the length in bytes of the parameter that follows. If the initiator sends a parameter

9. Comparison made at every update of cumulative value.

10. The RLEC bit in Mode Page $0A_H$ must also be 1.

length value that causes the parameter value to truncate, the drive terminates the command with a Check Condition status. The sense key is set to Illegal Request with additional sense code set to Invalid Field Parameter List.

Byte 4 The *parameter value* field uses 1, 2, 4 or 8 bytes to transmit an unsigned counter value. The initiator sends counts to set values into counters in the drive, and the drive returns counter values to the initiator. The initiator is responsible for issuing a Log Sense command to learn the parameter length the drive has selected.

3.8 Log Sense command ($4D_H$)

The Log Sense command ($4D_H$) provides a means for an initiator to manage the statistical data maintained by the drive about drive operation. Initiators that implement the Log Select command also implement the Log Sense command.

3.9 Reserve (10) command (56_H)

The Reserve (10) command is used to reserve a logical unit. The 3rd Party reservation allows logical units to be reserved for another specified SCSI device.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (56_H)							
1	Logical Unit Number (1)			3rd Party (2)	Reserved			Extent (3)
2	Reservation Identification (4)							
3	3rd Party Device ID not supported							
4	Reserved							
5	Reserved							
6	Reserved							
7–8	Extent List Length (3)							
9	Control Byte (5)							

Notes:

1. The Logical Unit Number must be 0.

2. If bit 4 is 0, byte 2 must also be 0.
If bit 4 is 1, byte 2 identifies the SCSI bus ID of the device for which the drive is reserved.

3. Extent not supported

4. Must be 0 if not supported by the drive.

5. Normally all zeros. Control Byte can be supported as a special factory-installed option.

3.10 Release (10) command (57_H)

The Release (10) command is used to release a previously reserved logical unit. It is not an error for an initiator to attempt to release a reservation that is not currently valid. In this case, the drive returns a GOOD status without altering any other reservation.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (57_H)							
1	Logical Unit Number (1)			3rd Party (2)	Reserved			Extent (3)
2	Reservation Identification (4)							
3	3rd Party Device ID (2)							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Control Byte (5)							

Notes:

1. The Logical Unit Number must be zero.

2. If bit 4 is 0, bits 3, 2, and 1 are 0. If bit 4 is 1, bits 3, 2 and 1 identify the SCSI bus ID of the device that reserves the drive.

3. Extent not supported

4. Must be zero if not supported by the drive.

5. Normally all zeros. Control Byte can be supported as a special factory-installed option.

3.11 Group 3 and 4 commands

Group 3 commands are reserved. Group 4 commands are 16-byte commands. Group 4 commands are not supported. If the drive receives one of these commands, it returns a check condition status.

Caution. Do not use Group 3 and 4 commands. If you do, you may destroy data on the disc.

3.12 Group 5 and 6 commands

Group 5 and 6 commands are 12-byte commands. Group 5 commands are not implemented. If the drive receives a Group 5 command, it returns a check condition status. Group 6 commands are reserved for Seagate use.

Caution. Do not use Group 6 commands. If you do, you may destroy data on the disc.

3.13 Group 7 commands

Group 7 commands are 10-byte commands. These commands are not implemented. If the drive receives one of these commands, it returns a check condition status.

Appendix A. Supported messages

A.1 Messages

The implemented 1- and 2-byte messages are listed below.

Code	Message name	Direction	Must negate ATN before last ACK?
06_H	Abort	O	Yes
$0D_H$	Abort tag	O	Yes
$0C_H$	Bus device reset	O	Yes
$0E_H$	Clear queue	O	Yes
00_H	Command complete	I	—
04_H	Disconnect	I	—
80_H	Identify	I/O	No
05_H	Initiator detected error	O	Yes
09_H	Message parity error	O	Yes
07_H	Message reject	I/O	Yes
08_H	No operation	O	Yes
21_H	Head of queue tag[11]	O	No
22_H	Ordered queue tag[11]	O	No
20_H	Simple queue tag[11]	O	No
23_H	Ignore Wide Residue[11]	I	—
02_H	Save data pointer	I	—

11. These are 2-byte messages.

A.2 Synchronous Data Transfer Request message (01_H)

The synchronous Data Transfer Request message is an extended message.

Depending on the value contained in the SSM bit (contained in byte 2 of the Operating page in Appendix D.2.2. on page 121), the drive or the initiator can negotiate for synchronous data transfer after a reset. If any problem precludes the successful exchange of synchronous Data Transfer Request messages, the initiator and drive default to asynchronous data transfers. Also, reception of a Wide Data Transfer Request message sets the drive to the default asynchronous transfers.

This exchange of messages establishes the minimum transfer period and the maximum allowed REQ/ACK offset.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	Extended message (01_H)							
1	Extended message length (03_H)							
2	Identifier code (01_H)							
3	Minimum transfer period divided by 4							
4	REQ/ACK offset							

Byte 0 This byte identifies the message as an extended message.

Byte 1 This byte reports the length of the message.

Byte 2 This byte identifies the message as a synchronous data transfer request message.

Byte 3 The value contained in this byte is in nsec. It is equal to the minimum period in which the device can receive data, in units of 4 nsec. In byte 3, the minimum value supported by the drive is $0C_H$, which is equivalent to a transfer period of 48 nsec, or a maximum external transfer rate of 20 Mbytes per second. A value of 19_H is equivalent to a transfer period of 100 nsec, or a maximum external transfer rate of 10 Mbytes per second. A value of 32_H is equivalent to a transfer period of 200 nsec, or a maximum external transfer rate of 5 Mbytes per second.

Byte 4 The *REQ/ACK offset* is the maximum number of REQ pulses that may be outstanding before its corresponding ACK pulse is received at the target. A REQ/ACK offset of zero indicates asynchronous mode. The drive supports a maximum REQ/ACK offset of $0F_H$.

A.2.1 Wide Data Transfer Request Message

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	Extended message (01_H)							
1	Extended message length (02_H)							
2	Wide Data Transfer Request code (03_H)							
3	Transfer Width Exponent							

The originating SCSI device (the SCSI device that sends the first pair of WDTR messages) sets its transfer value to the maximum data path it chooses to accommodate.

If the responding SCSI device can also accommodate this transfer width, it returns the same value in its WDTR message. If it requires a smaller transfer width, it substitutes a smaller value in its WDTR message. The successful completion of an exchange of WDTR messages implies an agreement as follows:

Responding Device WDTR Response	Implied Agreement
Nonzero transfer width	Each device transmits and receives data with a transfer width equal to the responding SCSI devices' transfer width
Transfer width equal to zero	8-bit data transfer
MESSAGE REJECT message	8-bit data transfer

Appendix B. Sense data

The appendix contains the descriptions for sense data returned by the Request Sense command. For more information on the Request Sense command, see the *Seagate SCSI-2/3 Interface Manual Volume 2; Version 2*, *publication number 77738479-F.*

B.1 Additional sense data

When the initiator issues a Request Sense command, the drive returns the following additional sense data.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Valid	Error code						
		1	1	1	0	0	0	X
1	Segment number (00_H)							
2	0	0	ILI	0	Sense key			
3–6	Information bytes							
7	Additional sense length							
8–11	Command specific data							
12	Additional sense code							
13	Additional sense code qualifier							
14	FRU code							
15	SKSV	Sense-key specific						
16–17	Sense-key specific							
18–21	Physical Location							

Byte 0 If the *valid* bit is one, the information bytes (bytes 3 through 6) are valid. If the valid bit is zero, the information bytes are not valid.

If *error code* contains a value of 70_H, the error occurred on the command that is currently pending. If *error code* contains a value of 71_H, the error occurred during the execution of a previous command for which a good status has already been returned.

Byte 1 The *segment number* is always zero.

Byte 2 If the *incorrect length indicator (ILI)* bit is zero, the requested block of data from the previous command did not match the logical block length of the data on the disc. If the ILI bit is one, the requested block of data from the previous command matched the logical block length of the data on the disc.

The *sense key* indicates one of nine general error categories. These error categories are listed in Appendix B.2 on page 93.

Bytes 3–6 When the *valid* bit is 1, the *information bytes* contain the logical block address of the current logical block associated with the sense key. For example, if the sense key is media error, the information bytes contain the logical block address of the offending block.

Byte 7 The *additional sense length* is limited to a maximum of $0E_H$ additional bytes. If the allocation length of the command descriptor block is too small to accommodate all of the additional sense bytes, the additional sense length is not adjusted to reflect the truncation.

Bytes 8–11 These bytes contain command-specific data.

Bytes 12–13 The *additional sense code* and *additional sense code qualifier* provide additional details about errors. See Appendix B.3 on page 94.

Byte 14 The *field replaceable unit (FRU) code* is used by field service personnel only.

Bytes 15–17 The SHSV bit and sense-key specific bytes.

Bytes 18–19 Physical cylinder

Byte 20 Physical head

Byte 21 Sector

Note. The Physical Location bytes contain the offending cylinder, head and sector if the valid bit is 1.

B.2 Sense key

The sense keys in the lower-order bits of byte 2 of the sense data returned by the Request Sense command are described in the following table. You can find a more detailed description of the error by checking the additional sense code and the additional sense code qualifier in Section B.3 on page 94.

Sense key	Description
0_H	**No Sense.** In the case of a successful command, no specific sense key information needs to be reported for the drive.
1_H	**Recovered error.** The drive completed the last command successfully with some recovery action. When many recovered errors occur during one command, the drive determines which error to report.
2_H	**Not ready.** The addressed logical unit cannot be accessed. Operator intervention may be required to correct this condition.
3_H	**Medium error.** The command was terminated with a nonrecoverable error condition, possibly caused by a flaw in the media or an error in the recorded data.
4_H	**Hardware error.** The drive detected a nonrecoverable hardware failure while performing the command or during a self-test. This includes, for example, SCSI interface parity errors, controller failures and device failures.
5_H	**Illegal request.** This indicates an illegal parameter in the CDB or in the additional parameters supplied as data for some commands (for example, the Format Unit command, the Mode Sense command and others). If the drive detects an invalid parameter in the CDB, it terminates the command without altering the media. If the drive detects an invalid parameter in the additional parameters supplied as data, the drive may have already altered the media.
6_H	**Unit attention.** The drive may have been reset. See the *Seagate SCSI-2 Interface Manual* for more details about the Unit Attention condition.
B_H	**Aborted command.** The drive aborted the command. The initiator may be able to recover by retrying.
E_H	**Miscompare.** The source data did not match the data read from the media.

B.3 Additional sense code and additional sense code qualifier

The additional sense code and additional sense code qualifiers returned in byte 12 and byte 13, respectively, of the Sense Data Format of the Request Sense command are listed in the following table.

Error code (hex)		
Byte 12	**Byte 13**	**Description**
00	00	No additional information is supplied.
01	00	There is no index/sector signal.
02	00	There is no seek complete signal.
03	00	A write fault occurred.
04	00	Drive not ready; no additional information
04	01	Drive not ready; in Spinup mode
04	02	Drive not ready; waiting for initialization
04	03	Drive not ready; human intervention required
04	04	Drive not ready; format in process
09	00	Track following error
11	00	An unrecovered read error occurred.
11	01	Read retries exhausted
11	02	Error too long to correct
11	04	Unrecoverable read error; Autoreallocation failed
14	00	No sector found
15	00	A seek positioning error occurred.
16	00	Data synchronization mark error.
17	01	The data was recovered with retries.
18	00	Data recovered with ECC
18	01	The data was recovered with ECC and retries.
18	02	The data was recovered and ARRE was performed.
19	00	There is an error in the defect list.
19	01	Defect list not available

Error code (hex)		
Byte 12	**Byte 13**	**Description**
19	02	Error in PList
19	03	Error in GList
1A	00	A parameter overrun occurred.
1C	00	The defect list could not be found.
1C	01	The primary defect list could not be found.
1C	02	GList not found
1D	00	A miscompare occurred during a verify operation.
20	00	The drive received an invalid command operation code.
21	00	The logical block address was not within the acceptable range.
24	00	The drive received a CDB that contains an invalid bit.
25	00	The drive received an invalid LUN.
26	00	The drive received an invalid field in the Parameter List.
26	01	CDB with unsupported parameter
26	02	CDB with invalid parameter
26	03	CDB with unsupported threshold parameter
29	00	A power-on reset or a bus device reset occurred.
2A	00	Parameter changed by another initiator
2A	01	The Mode Select parameters were changed by another initiator.
2A	02	Log parameters changed
2F	00	Commands cleared by another initiator
31	00	Medium format corrupted
32	00	No spare defect locations available.
39	00	Saved pages not found
3F	01	The firmware/microcode was changed.

Error code (hex)		
Byte 12	**Byte 13**	**Description**
40	00	Target operating conditions have changed
40	01	Buffer parity error detected
40	93	Error in write to flash.
43	00	A message error occurred.
44	00	An internal controller error occurred.
47	00	A SCSI bus parity error occurred.
48	00	The initiator detected an error.
49	00	The initiator receives an invalid message from the drive.
4E	00	The drive attempted to perform overlapped commands.

Appendix C. Mode pages

Mode pages are groups of parameters that the drive stores. These parameters can be read using the Mode Sense command and changed using the Mode Select command. These commands are described in Sections 3.4.10 and 3.4.13. on pages 48 and 53.

This appendix contains the default parameters and the directly changeable parameters for the mode pages. The current parameters and the saved parameters are not shown.

Note. The default values contained in this appendix may differ from the default values actually contained in your drive. To determine the default values, use the Mode Sense command.

Mode page	Page code	Bytes	Contains directly changeable parameters
Read-Write Error Recovery page	01_H	12	Yes
Disconnect/Reconnect page	02_H	16	Yes
Format Device page	03_H	24	No
Rigid Disc Geometry page	04_H	24	No
Verify error recovery page	07_H	12	Yes
Caching page (SCSI-3)	08_H	20	Yes
Control Mode page	$0A_H$	12	Yes
Unit Attention Page	00_H	4	Yes

For all mode pages:

- If the changeable value is 0, the initiator *cannot* change the bit directly. If the changeable value is 1, the initiator *can* change the bit directly.

  For example, in the mode page header, the changeable value for the page code bits is 0, which means that the page code cannot be changed; the changeable value of the PS bit is 1, which means that the PS bit can be changed.

- During the Mode Sense command, the PS (parameter savable) bit is 1, which means the mode page is saved on the disc. During the Mode Select command, you must set the PS bit to 0.
- An “X” means that the value of the bit cannot be specified. For example, the default value of bit 0 of byte 1 of page 00_H (the Operating page) cannot be specified because the bit can be either 1 or 0.

All mode pages contain a 2-byte header that contains the page code and the page length for that particular page. The header is shown below.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS	Page code						
changeable	1	0	0	0	0	0	0	0
1	Page length							
changeable	00_H							

Byte 0 During the Mode Sense command, the *PS* (parameter savable) bit is 1, which means the mode page is saved on the disc. During the Mode Select command, you must set the PS bit to 0.

The *page code* is the unique code that identifies the page.

Byte 1 The *page length* is the length, in bytes, of the page.

C.1 Read-Write Error Recovery page (01_H)

The Read-Write Error Recovery page is shown below. This table summarizes the function, the default value and the changeability of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS (1)	Page code (01_H)						
1	Page length ($0A_H$)							
2	AWRE	ARRE	TB	RC	EER	PER	DTE	DCR
default	0	0	0	0	1	0	0	0
changeable	1	1	1	1	1	1	1	1
3 (default)	Read retry count (20_H)							
changeable	FF_H							
4 (default)	Correction span (40_H)							
changeable	00_H							
5 (default)	Head offset count (00_H)							
changeable	00_H							
6 (default)	Data strobe offset count (00_H)							
changeable	00_H							

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Bytes	Bits							
	7	6	5	4	3	2	1	0
7 (default)	Reserved (00_H)							
changeable	00_H							
8 (default)	Write retry count (20_H)							
changeable	FF_H							
9 (default)	Reserved (00_H)							
changeable	00_H							
10–11 (default)	Recovery time limit ($FFFF_H$)							
changeable	0000_H							

Byte 2 When the *automatic write reallocation enabled (AWRE)* bit is 1, the drive automatically reallocates bad blocks detected while writing to the disc. When the AWRE bit is 0, the drive does not perform automatic reallocation; instead, the drive reports a check condition status with a sense key of media error.

Note. The AWRE bit does not apply during the Format command.

When the *automatic read reallocation enabled (ARRE)* bit is 1, the drive automatically reallocates bad blocks detected while reading from the disc. When the ARRE bit is 0, the drive does not automatically reallocate bad blocks. Instead, a check condition status is reported with a sense key of media error.

The *transfer block (TB)* bit is not supported.

When the *read continuous (RC)* bit is 1, the drive sends all data without making any corrections. This function supersedes other bits in this byte. When the RC bit is 0, the correction is performed according to the other bits in this byte.

When the *enable early recovery (EER)* bit is 1, the drive applies on-the-fly T>1 ECC correction as soon as possible, before it attempts other retry mechanisms, and without reporting successful corrections to the host as a recovered error. Seek error retries and message system errors are not affected by this bit. When this bit is set, the DCR bit must be 0. When the EER bit is 0, the drive applies ECC correction before other retry mechanisms, but does not perform T>1 corrections on-the-fly; any successful correction is reported to the host as a recovered error.

The *post error (PER)* bit is not supported.

The *disable transfer on error (DTE*) bit is not supported.

The *disable correction* (*DCR*) bit is not supported.

Byte 3 The *read retry count* field is the maximum number of times the drive attempts its recovery algorithms. The read retry count field has a range of 0 through 20_H.

Byte 4 The *correction span* is the size of the largest read data error, in bits, on which ECC correction is attempted. The drive can correct up to 64 bits. Longer errors are reported as nonrecoverable.

Byte 5 The *head offset count* is not implemented. Head offsets are performed as part of the drive's retry algorithms.

Byte 6 The *data strobe offset count* is not implemented.

Byte 7 Reserved

Byte 8 The *write retry count* field contains the maximum number of times the drive attempts its recovery algorithms. The write retry count field has a range of 0 through 20_H.

Byte 9 Reserved

Bytes 10–11 The *recovery time limit* field always has a value of $FFFF_H$, which means that the recovery time is unlimited.

C.2 Disconnect/Reconnect page (02_H)

The Disconnect/Reconnect page is shown below. This table summarizes the function, the default value and the changeability of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS (1)	Page code (02_H)						
1	Page length ($0E_H$)							
2 (default)	Buffer full ratio (99_H)							
changeable	FF_H							
3 (default)	Buffer empty ratio (99_H)							
changeable	FF_H							
4–5 (default)	Bus inactivity limit (0000_H)							
changeable	0000_H							

continued

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6–7 (default)	Disconnect time limit (0000_H)
changeable	0000_H
8–9 (default)	Connect time limit (0000_H)
changeable	0000_H
10–11 (default)	Reserved (0000_H)
changeable	0000_H
12–15 (default)	Reserved (00000000_H)
changeable	00000000_H

Byte 2 The *buffer full ratio* field indicates, on Read commands, how full the drive's buffer is before reconnecting. The drive rounds up to the nearest whole logical block. This parameter is the numerator of a fraction that has 256 as its denominator.

Byte 3 The *buffer empty ratio* field indicates, on Write commands, how empty the drive's buffer is before reconnecting to fetch more data. The drive rounds up to the nearest whole logical block. This parameter is the numerator of a fraction that has 256 as its denominator.

Bytes 4–5 The *bus inactivity limit* field indicates the time, in 100-µsec increments, that the drive can assert the Busy signal without handshakes until it disconnects. The drive can round down to its nearest capable value. If the bus inactivity limit is 0000_H, the drive maintains the BSY– signal for 1 msec without handshakes.

Bytes 6–7 The *disconnect time limit* field indicates the minimum time, in 100-µsec increments, that the drive remains disconnected until it attempts to reconnect. A value of 0 indicates that the drive is allowed to reconnect immediately.

Bytes 8–9 The *connect time limit* field indicates the maximum time, in 100-µsec increments, that the drive should remain connected until it attempts to disconnect. The drive may round to its nearest capable value. A value of 0 means that the drive can remain connected indefinitely until it tries to disconnect.

Bytes 10–11 Reserved

Bytes 12–15 Reserved

C.3 Format Device page (03_H)

The Format Device page is shown below. This table summarizes the function, the default value and the changeability of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS (1)	Page code (03_H)						
1	Page length (16_H)							
2–3 (default)	Tracks per zone ($0000_{H)}$							
changeable	0000_H							
4–5 (default)	Alternate sectors per zone ($07D0_H$)							
changeable	0000_H							
6–7 (default)	Alternate tracks per zone (0000_H)							
changeable	0000_H							
8–9 (default)	Alternate tracks per volume (0000_H)							
changeable	0000_H							
10–11 (default)	Sectors per track ($00A1_H$)							
changeable	0000_H							
12–13 (default)	Data bytes per physical sector (0200_H)							
changeable	0000_H							
14–15 (default)	Interleave (0001_H)							
changeable	0000_H							
16–17 (default)	Track skew factor (00024_H)							
changeable	0000_H							
18–19 (default)	Cylinder skew factor (0034_H)							
changeable	0000_H							
20	SSEC	HSEC	RMB	SURF	Reserved			
default	0	1	0	0				
changeable	0	0	0	0	0	0	0	0
21–23 (default)	Reserved (000000_H)							
changeable	000000_H							

Bytes 2–3 The *tracks per zone* field indicates the number of tracks the drive allocates to each defect-management zone. Spare sectors or tracks are placed at the end of each defect-management zone. If each zone is treated as containing one track, the valid value for tracks per zone is 1. If each zone is treated as containing one cylinder, the valid value is equal to the number of read/write heads. The drive supports only one zone for the entire drive.

Bytes 4–5 The *alternate sectors per zone* field indicates the number of spare sectors to be reserved at the end of each defect-management zone. The drive defaults to $7D0_H$ (2000) spare blocks at the end of the volume.

Bytes 6–7 The *alternate tracks per zon*e field indicates the number of spare tracks the drive reserves at the end of each defect-management zone. A value of 0 indicates that no spare tracks are reserved at the end of each zone for defect management.

Bytes 8–9 The *alternate tracks per volume* field indicates the number of spare tracks to be reserved at the end of the drive for defect management. A value of 0 indicates that no spare tracks are reserved at the end of each zone for defect management.

Bytes 10–11 The *sectors per track* field indicates the number of physical sectors the drive allocates per track. The drive reports the average number of physical sectors per track because the number of sectors per track varies between the outer and inner tracks.

Bytes 12–13 The *data bytes per physical sector* field indicates the number of data bytes allocated per physical sector.

Bytes 14–15 The *interleave* field is the interleave value sent to the drive during the last Format Unit command. This field is valid only for Mode Sense commands. The drive ignores this field during Mode Select commands. The interleave is always 1:1.

Bytes 16–17 The *track skew factor*[12] field indicates the number of physical sectors on the media between the last logical block of one track and the first logical block of the next sequential track of the same cylinder. The actual track skew factor that the drive uses is different for every zone.

12. The skew is actually in units of servo bursts, which are not visible through the interface. The values shown is the skew approximated to the nearest sector.

The default value is 0024_H, which is the track skew factor for the first zone.

Bytes 18–19 The *cylinder skew factor*[12] field indicates the number of physical sectors between the last logical block of one cylinder and the first logical block of the next cylinder. The actual cylinder skew factor that the drive uses depends on the zone. The default value is 0034_H, which is the cylinder skew factor for the first zone.

Byte 20 The *drive type* field bits are defined as follows:

The *soft sectoring (SSEC)* bit is set to 1. This bit is reported as not changeable. Although it can be set to satisfy system requirements, it does not affect drive performance.

The *hard sectoring (HSEC)* bit is set to 0. This bit is reported as not changeable. Although it can be set to satisfy system requirements, it does not affect drive performance.

The *removable media (RMB)* bit is always set to 0, indicating that the drive does not support removable media. This same bit is also returned in the Inquiry parameters.

The *surface map (SURF)* bit is set to 0, indicating that the drive allocates successive logical blocks to all sectors within a cylinder before allocating logical blocks to the next cylinder.

Bytes 21–23 Reserved

C.4 Rigid Disc Geometry page (04_H)

The Rigid Disc Geometry page is shown below. This table summarizes the function, the default value and the changeability of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS (1)	Page code (04_H)						
1	Page length (16_H)							
2–4	Number of cylinders (1988_H)							
changeable	000000_H							
5	Number of heads (04_H)							
changeable	00_H							
6–8	Starting cylinder for write precompensation							

Bytes	Bits							
	7	6	5	4	3	2	1	0
default	000000_H							
changeable	000000_H							
9–11	Starting cylinder for reduced write current							
default	000000_H							
changeable	000000_H							
12–13 (default)	Drive step rate (0000_H)							
changeable	0000_H							
14–16 (default)	Loading zone cylinder (000000_H)							
changeable	000000_H							
17 (default)	Reserved (00_H)							
changeable	00_H							
18 (default)	Rotational offset (00_H)							
changeable	00_H							
19 (default)	Reserved (00_H)							
changeable	00_H							
20–21	Media rotation rate							
default	1515_H							
changeable	0000_H							
22–23 (default)	Reserved (0000_H)							
changeable	0000_H							

Bytes 2–4 The number of cylinders field specifies the total number of cylinders, including 2,000 spare blocks at the end of the volume. The user-accessible cylinders may be less. The drive's first requirement is the user capacity, not the number of cylinders. The drive slips defects during format unit, so the maximum LBA's physical location depends on the number of slipped sectors. The slipping of LBAs across the drive volume increases the data throughput. The drive uses the additional cylinders for storing parameters and defect lists or for diagnostic purposes.

Byte 5 The *number of heads* field specifies the number of read/write heads on the drive.

Bytes 6–16 The *starting cylinder for reduced write current*, *starting cylinder for reduced read current, drive step rate* and

loading zone cylinder bytes are not supported by the drive.

Byte 17 Reserved. RPL is not supported.

Byte 18 The rotational offset is not supported.

Byte 19 Reserved

Bytes 20–21 The medium rotation rate is the spindle speed.

Bytes 22–23 Reserved

C.5 Verify error recovery page (07_H)

The verify error recovery page specifies the error-recovery parameters the target uses during the Verify command and the verify operation of the Write and Very commands.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS (1)	RSVD (0)	Page code (07_H)					
1	Parameter length ($0A_H$)							
2	Reserved				EER	PER	DTE	DCR
default	0	0	0	0	1	0	0	0
changeable	0	0	0	0	1	1	1	1
3 (default)	Verify retry count (20_H)							
changeable	FF_H							
4 (default)	Verify correction span (40_H)							
changeable	00_H							
5 (default)	Reserved (00_H)							
changeable	00_H							
6 (default)	Reserved (00_H)							
changeable	00_H							
7 (default)	Reserved (00_H)							
changeable	00_H							
8 (default)	Reserved (00_H)							
changeable	00_H							
9 (default)	Reserved (00_H)							
changeable	00_H							
10–11 (default)	Verify Recovery time limit ($FFFF_H$)							
changeable	00_H							

Byte 2 When the *enable early recovery (EER)* bit is 1, the drive applies on-the-fly T>1 ECC correction as soon as possible, before it attempts other retry mechanisms, and without reporting successful corrections to the host as a recovered error. Seek error retries and message system errors are not affected by this bit. When this bit is set, the DCR bit must be 0. When the EER bit is 0, the drive applies ECC correc-

tion before other retry mechanisms, but does not perform T>1 corrections on-the-fly; any successful correction is reported to the host as a recovered error.

The post error (PER) bit is not supported.

The *disable transfer error (DTE)* bit is not supported.

The *disable correction (DCR)* bit is not supported.

Byte 3 The *verify retry count* field specifies the number of times the target attempts its recovery algorithm during a verify operation. The verify retry count field has a range of 0 through 20_H.

Byte 4 The *verify correction span* is the size of the largest read data error, in bits, on which ECC correction is attempted. The drive can correct up to 64 bits. Longer errors are reported as nonrecoverable.

Byte 5–9 Reserved

Byte 10–11 The *verify recovery time limit* field has a value of $FFFF_H$, which means that recovery time is unlimited.

C.6 Caching page (08_H)

The drive uses read look-ahead, read caching and write caching to improve seek times and performance.

C.6.1 Read look-ahead and caching

The drive uses an algorithm that improves seek performance by reading the next logical sectors after the last requested sector. These unrequested sectors are read into a buffer and are ready to be transmitted to the host before they are requested. Because these sectors are read before they are requested, access read time for the sectors is virtually eliminated. This process is called read look-ahead.

Read Caching is any time data read for a command is available to be sent to an initiator for a subsequent command.

The buffer used for read look-ahead and caching can be divided into segments as shown in the following table. To change the number of segments, use byte 13 of the Caching page, which is described in Appendix C.6.3. on page 110. The default is one 128-Kbyte segment.

Number of segments	Size of segment (in Kbytes)
1	96
2	48
4	24

When the buffer is divided into multiple segments, each segment functions as an independent buffer, causing dramatically increased performance in multitasking and multiuser environments at the expense of poorer performance commands with long transfer lengths.

C.6.2 Write caching and write merging

Write caching. The drive uses a segment to store Write data. After the drive receives the data from the initiator and caches the data, the command is terminated and the drive is ready to process new commands. The drive writes data to the disc before processing any nonwrite command.

Write merging. Write merging uses the Write Immediate function. Write Immediate terminates the command as soon as the initiator data is sent. Write Immediate can be performed on an isolated write command. If Write Immediate is used on write commands that are close enough in time that the initiator data is present from the subsequent command before the original command's data is completely written to disc, then the two write commands can be merged. The problem with this option is that status is sent before the data is written to the disc. For disc errors, SCSI has a function called Deferred Error reporting; the next command sent receives a CHECK CONDITION status, and the SENSE data reports a deferred error for the Write that had the error. The command that had the CHECK CONDITION status may not be related to the Write error.

C.6.3 Caching page description

The Caching page is shown below. This table summarizes the function, the default value and the changeability of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS (1)	Page code (08_H)						
1	Page length (12_H)							
2	IC	ABPF	CAP	DISC	SIZE	WCE	MF	RCD
default	1	0	0	1	0	1	0	0
changeable	0	0	0	0	0	1	1	1
3	Demand read retention priority				Write retention priority			
default	0	0	0	0	0	0	0	0
changeable	0	0	0	0	0	0	0	0
4–5 (default)	Disable prefetch transfer length ($FFFF_H$)							
changeable	0000_H							
6–7 (default)	Minimum prefetch (0000_H)							
changeable	$FFFF_H$							
8–9 (default)	Maximum prefetch ($FFFF_H$)							
changeable	$FFFF_H$							
10–11 (default)	Maximum prefetch ceiling ($FFFF_H$)							
changeable	$FFFF_H$							
12	FSW	Rsrvd	DRA	Reserved				
default	1	0	0	0	0	0	0	0
changeable	0	0	1	0	0	0	0	0
13	Number of cache segments							
default	01_H							
changeable	FF_H							
14–15 (default)	Cache segment size (0000_H)							
changeable	0000_H							
16 (default)	Reserved (00_H)							
changeable	00_H							
17–19 (default)	Noncache segment size (000000_H)							
changeable	000000_H							

Byte 2 The *initiator control (IC)* bit is not supported.

When the *abort prefetch (ABPF)* bit is 0, the drive controls completion of prefetch. See the description for the DISC bit below. This is the default value and it is not changeable.

The *caching analysis permitted (CAP)* bit is not supported.

When the *discontinuity (DISC)* bit is 1, the drive may prefetch across cylinder boundaries, where head seeks consume additional processing time. This is the default value and it is not changeable.

The *size enable (SIZE)* bit is not supported.

When the *write cache enable (WCE)* bit is 0, the drive returns a good status for a Write command after successfully writing all the data to the media. When the WCE bit is 1, the drive returns a good status for a Write command after successfully receiving the data and usually before writing it to the media.

When the *multiplication factor (MF)* bit is 0, the drive interprets the *minimum prefetch* and *maximum prefetch* fields as the number of logical blocks to be prefetched. When the MF bit is 1, the drive interprets the minimum prefetch and maximum prefetch fields in terms of a number which, when multiplied by the transfer length of the current command, yields the number of logical blocks to be prefetched.

When the *read cache disable (RCD)* bit is 0, the drive may return data requested by a Read command by accessing either the cache or the media. If the RCD bit is 1, the cache is not used.

Byte 3 The *demand read retention priority* field is not used. The initiator cannot assign any special retention priority to the drive.

The *write retention priority* field is not used. The initiator cannot assign any special retention priority to the drive.

Bytes 4–5 The *disable prefetch transfer length* always has a value of $FFFF_H$, which means that the drive attempts an anticipatory prefetch for all Read commands.

Bytes 6–7 The *minimum prefetch* field specifies the minimum number of blocks the drive prefetches, regardless of the delays it may cause in executing subsequent pending commands. When the minimum prefetch field contains 0, the

drive terminates prefetching whenever another command is ready to be executed. If the minimum prefetch equals the maximum prefetch, the drive prefetches the same number of blocks regardless of whether there are commands pending.

Bytes 8–9 The *maximum prefetch* field specifies the maximum number of blocks the drive prefetches during a Read command if there are no other commands pending. The maximum prefetch field represents the maximum amount of data to prefetch into the cache for any single Read command.

Bytes 10–11 The *maximum prefetch ceiling* field should be equal to the maximum prefetch field. The maximum prefetch ceiling and maximum prefetch fields are the same if the MF bit is 0.

Byte 12 The *force sequential write (FSW)* bit that is set to 1 indicates that multiple block writes are to be transferred over the SCSI bus and written to the media in an ascending, sequential, logical block order.

When the *disable read-ahead (DRA)* bit is 1, the drive does not read into the buffer any logical blocks beyond the addressed logical blocks. When the DRA bit is 0, the drive can continue reading logical blocks into the buffer beyond the addressed logical blocks.

Byte 13 The *number of cache segments* field determines the number of segments into which the cache should be divided. Valid values are 1, 2, 4, 8, 16 and 32.

Bytes 14–15 The *cache segment size* field indicates the segment size in bytes. The cache segment size field is valid only when the SIZE bit is 1.

Byte 16 Reserved

Bytes 17–19 The *noncache segment size* field always contains zeros. This means that the entire buffer is available for caching.

C.7 Control Mode page ($0A_H$)

The Control Mode page is shown below. This table summarizes the function, the default value and the changeability of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS (1)	Page code ($0A_H$)						
1	Page length ($0A_H$)							
2	Reserved							RLEC
default	0	0	0	0	0	0	0	0
changeable	0	0	0	0	0	0	0	0
3	Queue algorithm modifier				Reserved		QErr	DQue
default	0	0	0	1	0	0	0	0
changeable	1	1	1	1	0	0	0	1
4	EECA	Reserved				RAENP	UAAENP	EAENP
default	0	0	0	0	0	0	0	0
changeable	00_H							
5 (default)	Reserved (00_H)							
changeable	00_H							
6–7 (default)	Ready AEN hold-off period (0000_H)							
changeable	0000_H							
8–9 (default)	Busy timeout period ($FFFF_H$)							
changeable	0000_H							
10–11 (default)	Reserved (0000_H)							
changeable	0000_H							

Byte 2 The RLEC bit is not implemented.

Byte 3 The queue algorithm modifier field is only effective if the disable queuing bit is zero. When bit 4 in the queue algorithm modifier field is 1, the drive may use tagged command queuing to change the order in which it executes commands. When bit 4 in the queue algorithm modifier field is 0, the drive always executes commands according to the order sent by the initiator.

When the *disable queuing (DQue)* bit is 0, tagged command queuing is enabled. When the *DQue* bit is 1, tagged command queuing is disabled.

Byte 4 Not implemented

Byte 5 Reserved

Bytes 6–7 Not implemented

Bytes 8–9 The busy time-out period field contains the maximum possible value, which means that the drive remains busy an unlimited amount of time.

Bytes 10–11 Reserved

C.7.1 Unit Attention Parameters (00_H)

The Unit Attention Parameters are shown in the table below. This table shows the function, the default value and the changeability of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS (1)	Page code (0_H) 0	0	0	0	0	0	0
1	Page length (in bytes)							
2	Rsrvd	SSM (2)	IL (3)	Unit-Attn (4)	Reserved		Strict (5)	Rsrvd
default	0	0	0	0	0	0	1	0
changeable	0	1	0	1	0	0	0	0
3 (default)	00_H							
changeable	00_H							

Notes:

1. A PS bit of one indicates that the drive is capable of saving the page in a nonvolatile vendor-specific location (used only with the Mode Sense command).

2. If the enable Synchronous Select Mode (SSM) bit is 1, the drive initiates for WDTR and SDTR messages. It initiates only if required (after a reset, reset message or power cycle). If the SSM bit is 0, the drive does not initiate WDTR or SDTR messages, regardless of negotiated conditions before reset, reset messages or a power cycle.

3. Inquiry Length (IL) bit. The IL bit is zero; 148 bytes of standard Inquiry data is available.

4. When the Unit Attention bit is 0, normal Unit Attention condition is generated as per Publication 77738479 Rev F. Section 4.6 - Unit Attention Condition. If the bit is 1, the drive does not generate a Unit Attention Condition during power up or after a Reset. However, if the first command is a Request Sense command, the sense data will reflect a Power-on or Reset was detected.

5. The Strict bit is set to 1. The drive checks for Initiator attempts to change unchangeable parameters. If the drive detects an attempt, it rejects the command in the standard way (such as Check Condition Status from drive, Request Sense from the Initiator and Illegal Request sense key (5_H), back from the drive.

Appendix D. Inquiry data

When the initiator issues an Inquiry command, the drive returns either inquiry data or vital product data, depending on the value in the EVPD bit in byte 1 of the Inquiry command descriptor block.

Both types of data are discussed in this appendix. The Inquiry command is described in Section 3.4.9. on page 47.

D.1 Inquiry data

When the initiator issues an Inquiry command, and the EVPD bit in byte 1 of the Inquiry command descriptor block is 0, the drive returns the following data. If the EVPD bit in byte 1 of the Inquiry command descriptor block is 1, see Appendix D.2 on page 120.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral qualifier			Peripheral device type				
	0	0	0	0	0	0	0	0
1	RMB	Device type qualifier						
	0	0	0	0	0	0	0	0
2	ISO version		ECMA version			ANSI version		
	0	0	0	0	0	0	1	0
3	AENC	TrmIOP	Reserved		Response data format			
	0	0			0	0	1	0
4	Additional length ($8F_H$)							
5–6	Reserved (00_H)							
7	RelAdr	Wbus32	Wbus16	Sync	Linked	0	CmdQue	SftRe
8–15	Vendor identification							
16–31	Product identification							
32–35	Product revision level							
36–43	Drive serial number							
44–95	Reserved							
96–143	Copyright notice							
144–147	Servo PROM part number							

Byte 0 The *peripheral qualifier* field contains a zero, except for nonzero LUNs, which means that the drive is currently connected to the logical unit that is issuing the Inquiry command.

The *peripheral device type* field contains a zero, which means that the drive is a direct-access device.

Byte 1 The *RMB* bit is 0, which means the discs are not removable.

The *device type qualifier is user-programmable.*

Byte 2 The *ISO version* field contains a zero, which means that we do not claim compliance with ISO 9316.

The *EMCA version* field contains a zero, which means that we do not claim compliance with EMCA-111.

The *ANSI version* field contains a two, which means that the drive complies with ANSI SCSI-2 standard X3.131-199x.

Byte 3 The *asynchronous event notification (AENC)* bit is zero, which means that the drive does not support asynchronous event notification.

The *terminate I/O process (TrmIOP)* bit is zero, which means that the drive does not support the terminate I/O process message.

The *response data format* field contains a two, which means that the inquiry data is in standard SCSI-2 format.

Byte 4 The *additional length* field contains 143, which is the number of bytes contained in the inquiry data beyond byte 4. This value represents a total inquiry data length of 148 bytes. If the allocation length in the CDB of the Inquiry command is less than 148, the inquiry data is truncated, but the additional length does not change.

Bytes 5–6 Reserved

Byte 7 The *RelAdr* bit is 0, which means that the drive does not support the relative addressing mode.

The *WBUS32* bit is 0, which means that the drive does not support 32-bit data transfers.

The *WBUS16* bit is 0, which means that the drive does not support 16-bit data transfers.

The *SYNC* bit is 1, which means that the drive supports synchronous data transfer.

The *Linked* bit is 0, which means that the drive does not support linked commands.

The *CmdQue* bit is 1, which means that the drive supports tagged command queuing.

The *Soft Re* bit is 0, which means that the drive responds to a soft reset with a hard reset.

Bytes 8–15 The *vendor identification* field contains SEAGATE in ASCII text.

Bytes 16–31 The *product identification* field contains the model number of the drive in ASCII text.

Bytes 32–35 The *product revision level* field contains the last four digits of the firmware release number in ASCII text.

Bytes 36–43 The *drive serial number* field contains the serial number of the drive in ASCII text.

Bytes 44–95 These bytes are reserved; they contain only zeros.

Bytes 96–143 The *copyright notice* field contains the following ASCII string: " Copyright (c) 1996 Seagate. All rights reserved."

Bytes 144–147 This is the *servo PROM part number* field.

D.2 Vital product data pages

When the initiator issues an Inquiry command, and the EVPD bit in byte 1 of the Inquiry command descriptor block is 1, the drive returns vital product data pages. If the EVPD bit in byte 1 of the Inquiry command descriptor block is 0, see Appendix D.1 on page 117.

All vital product data pages contain a 4-byte header, shown below.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	Peripheral qualifier			Peripheral device type				
1	Page code							
2	Reserved (00_H)							
3	Page length							

Byte 0 The *peripheral qualifier* field contains zero, which means that the drive is currently connected to the logical unit that issues the Inquiry command.

The *peripheral device type* field contains zero, which means that the drive is a direct-access device.

Byte 1 The *page code* field contains the same value contained in the page code field in byte 2 of the Inquiry command descriptor block.

If the page code field contains any of the page codes shown in the table below, the drive returns the corresponding page. The available page codes are:

Page code	Description
00_H	Supported vital product data pages
80_H	Unit serial number page
81_H	Implemented operating definitions page
$C0_H$	Firmware numbers page (vendor-unique)
$C1_H$	Date code page (vendor-unique)
$C2_H$	Jumper settings page (vendor-unique)

Byte 2 Reserved

Byte 3 The *page length* field contains the length of the supported page list.

D.2.1 Unit Serial Number page (80_H)

The Unit Serial Number page is shown below. The table summarizes the function and the default value of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral qualifier			Peripheral device type				
1	Page code (80_H)							
2	Reserved (00_H)							
3	Page length (08_H)							
4–11	Product serial number							

Bytes 4–11 The product serial number field contains the serial number for the drive in ASCII. If the drive does not return the serial number, it returns spaces (20_H).

D.2.2 Implemented Operating Definition page (81_H)

The Implemented Operating Definition page is shown below. The table summarizes the function and the default value of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral qualifier			Peripheral device type				
1	Page code (81_H)							
2	Reserved (00_H)							
3	Page length (03_H)							
4	SAVIMP	Current operating definition						
	0							
5	SAVIMP	Default operating definition						
	0							
6	SAVIMP	Supported operating definition						
	0							

Byte 4 The current operating definition field contains the value of the current operating definition.

Byte 5 The SAVIMP bit is always 0; therefore, the current operating definition parameter cannot be saved. If the SAVIMP bit is 1, the current operating parameter can be saved.

The default operating definition field contains the value of the default operating definition. If no operating definition is saved, the drive uses the default operating definition.

Bytes 6–8 If the SAVIMP bit is 0, the default definition parameter cannot be saved. If the SAVIMP bit is 1, the default definition parameter can be saved.

The supported operating definition field contains the value of the supported operating definition. If no supported operating definition is saved, the drive uses the default operating definition.

D.2.3 Firmware Numbers page ($C0_H$)

The Firmware Numbers page is shown below. The table summarizes the function and default value of each bit.

Bytes	Bits							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral qualifier			Peripheral device type				
1	Page code ($C0_H$)							
2	Reserved (00_H)							
3	Page length (0CH)							
4–7	Controller firmware number							
8–11	Boot firmware number							
12–15	Servo firmware number							

Bytes 4–7 The controller firmware number field contains the controller firmware number in ASCII text.

Bytes 8–11 The boot firmware number field contains the boot firmware number in ASCII text.

Bytes 12–15 The servo firmware number field contains the servo firmware in ASCII text.

D.2.4 Date Code page ($C1_H$)

The Date Code page is shown below. The table summarizes the function and the default value of each bit.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	Peripheral qualifier			Peripheral device type				
1	Page code ($C1_H$)							
2	Reserved (00_H)							
3	Page length (03_H)							
4	Year							
5–6	Week							

Bytes 4 The *year* field contains the year, in ASCII, that the firmware was released.

Bytes 5–6 The *week* field contains the week, in ASCII, that the firmware was released.

D.2.5 Jumper Settings page ($C2_H$)

The Jumper Settings page is shown below. The table summarizes the function and the default value of each bit.

Bytes	Bits							
	7	6	5	4	3	2	1	0
0	Peripheral qualifier			Peripheral device type				
1	Page code ($C2_H$)							
2	Reserved (00_H)							
3	Page length (01_H)							
4	Rsrvd	MS	Rsrvd	PE	Rsrvd	SCSI ID		

Byte 4 If the *motor start (MS)* bit is 1, the remote start enable jumper is installed on pins 15 and 16 of the options jumper block. If the MS bit is 0, the remote start enable jumper is not installed.

If the *parity enable (PE)* bit is 1, the parity enable jumper is installed on pins 17 and 18 of the options jumper block. If the PE bit is 0, the parity enable jumper is not installed.

SCSI ID is the SCSI ID of the drive.

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Publication Number: 32650-001, Rev. A, Printed in USA